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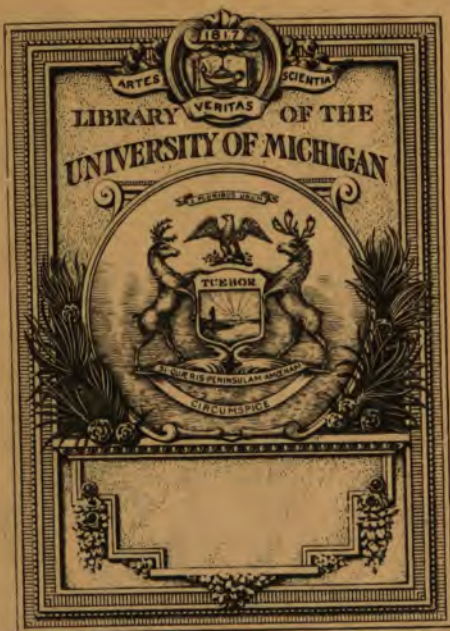
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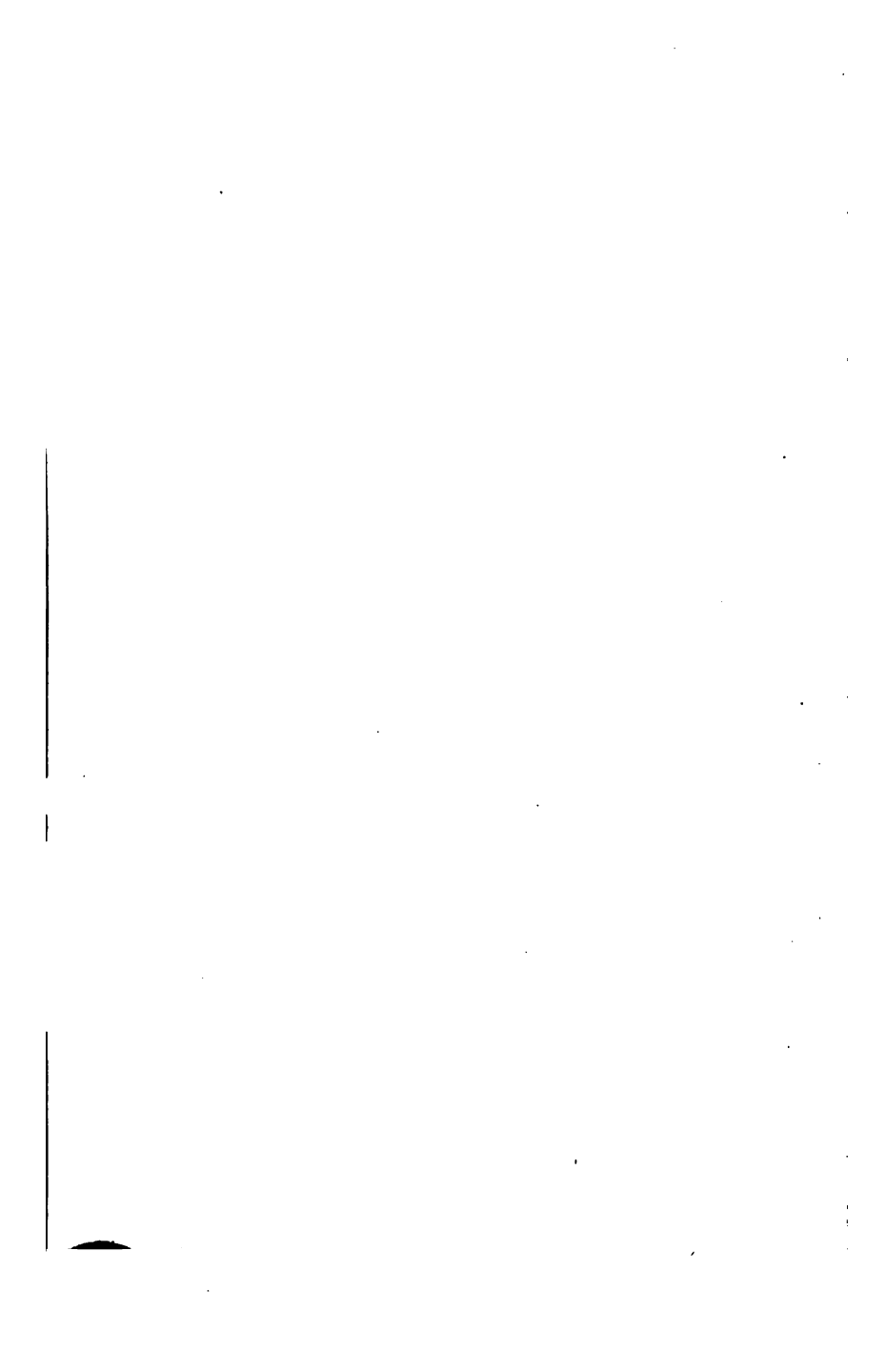


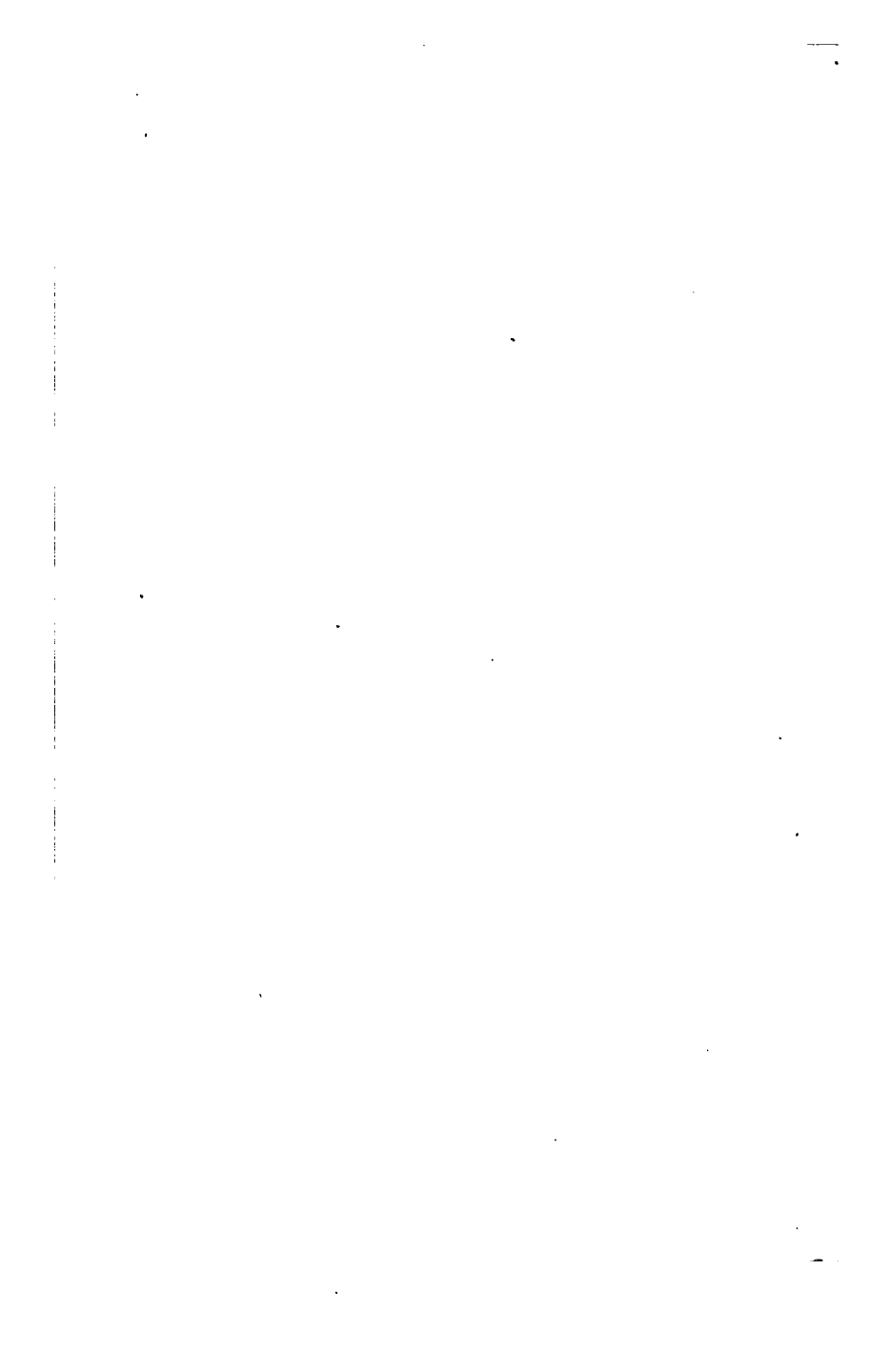
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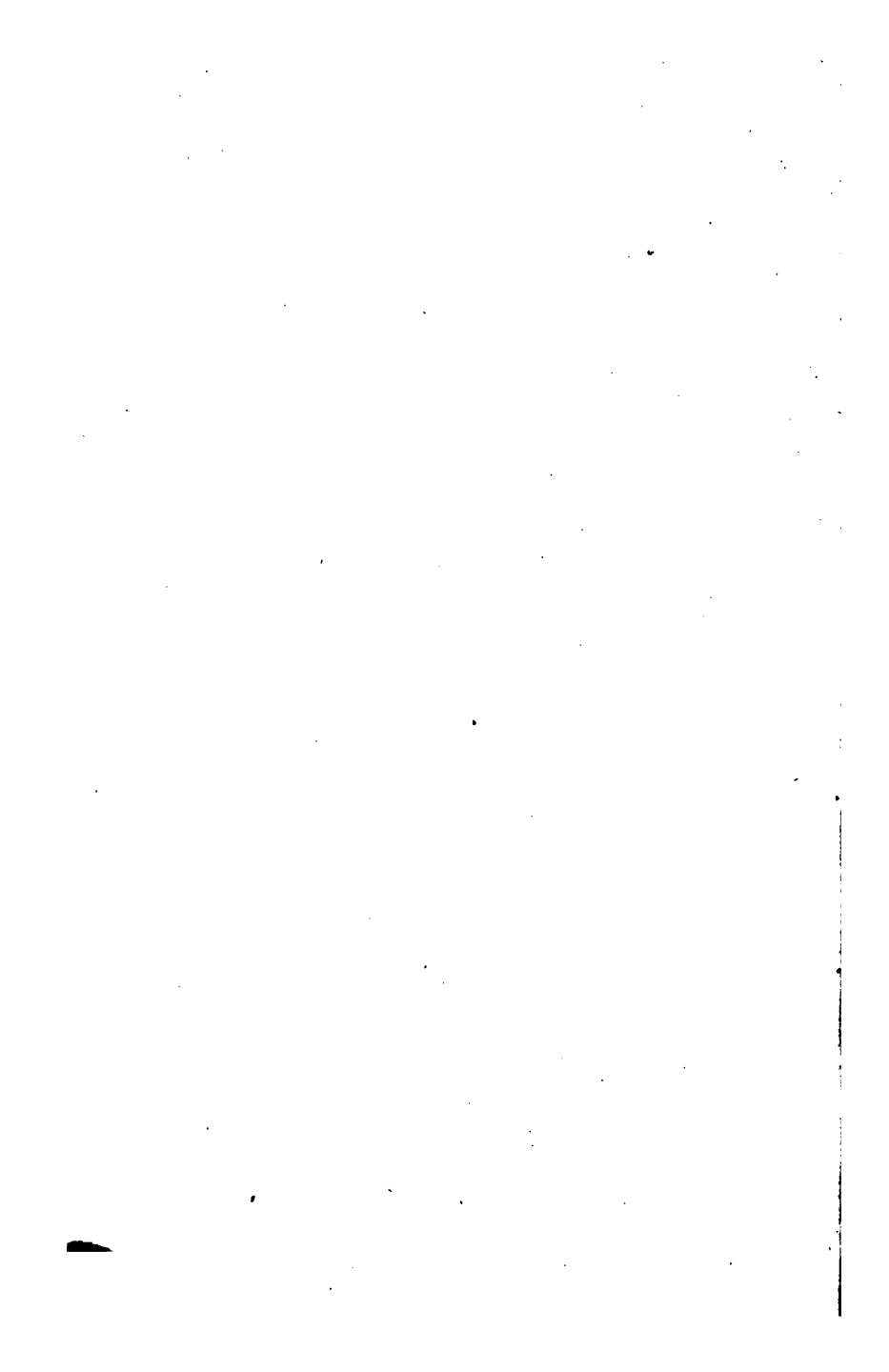
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THE
Newe Attractive,
SHEWING
The NATURE, PROPERTIE, and
manifold VERTUES of the
LOADSTONE;
WITH THE
Declination of the NEEDLE,
Touched therewith, under the Plaine
of the HORIZON.

Found out and Discovered
By ROBERT NORMAN.

L O N D O N:
Reprinted in the Year MDCCXX.

THE

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OF

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ARTS

AND

SCIENCE

OF

THE

UNITED STATES

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TO THE

READER.



ANY and divers ancient Authors, Philosophers and others, have written of the Magnes or Loadstone, as also of the substance, vertue and operation, and thereupon setting downe their opinions and judgments, have left the same as infallible truths for them that shall succcede. And as I may not, nor mean not herein willingly to condemne the learned or ancient writers, that have with great diligence laboured to discover the secrets of Nature in sundrie things, with their operations and Causes: yet I meane God-willing, without derogating from them, or exalting my self, to set downe a late experimented truth found in this stone, contrary to the opinions of all them that have heeretofore written thereof. Wherein I meane not to use

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barely, tedious Conjectures or imaginations : but briefly as I may to passe it over, grounding my Arguments onely upon experience, reason, and demonstration, which are the grounds of Arts. And albeit, it may be said by the learned in the Mathematicall, as hath beene already written by some, that this is no question or matter for a Mechanitian or Mariner to meddle with, no more then is the finding of the Longitude, for that it must bee handled exquisitely by Geometricall demonstration, and Arithmeticall Calculation : in which Artes, they would have all Mechanicians and Sea-men to be ignorant, or at leaste insufficientlie furnished to performe such a matter, alledging against them the latin Proverb of Apelles, Ne tutor ultra crepidam. But I doe verily thinke, that notwithstanding the learned in those Sciences, being in their studies amongst their bookes, can imagine greate matters, and set downe their furre fetched conceits, in faire shewe, and with plausible wordes, wishing that all Mechanicians were such, as for want of utterance, should be forced to deliver unto them their knowledge and conceites, that they might flourish upon them, and applye them at their pleasures : yet there are in this land divers Mechanicians, that in their severall faculties and professions, have the use of those Artes at their fingers endes, and can apply them to their severall purposes, as effectually and more readily, then those that would most condemne them. For albeit they have not the use of the Greeke and

Latin

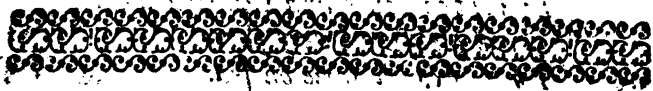
Latin Tongues, to search the varietie of Authors in those Artes, yet they have in English for Geometrie, Euclides Elements, with absolute demonstrations: and for Arithmeticke, Records workes, both his first and second part: and divers others, both in English, and in other vulgar languages, that have all written of them; which bookes are sufficient to the industrious Mechanician, to make him perfect and ready in those Sciences, but especially to apply the same to the Art and faculty which he chiefly professeth. And therefore I woulde wish the learned to use modesty in publishing their conceits, and not disdainfully to condemne men that will search out the secrets of their Artes and professions, and publish the same to the behoofe and use of others, no more then they woulde that others should judge of them, for promising much, and performing little or nothing at all. Aristotle saith, that every man is best to be beleaved in his owne professed Art and Science. Now (curteous Reader) I am to request thee to accept of this my discourse, wherein I have taken some paines (as the travaile it self it may testify) and beene at some charge, for the more carefull and orderly handling of such matters as are necessarily incident to this present treatise: All which I have beene content to doe, that the worke (though it be not big, yet effectual) by the common use thereof, may yeelde profit accordingly, to them specially that are of capacitie to comprehend this new revealed secret. To conclude, the chiefeſt
and

and onely marke whereat I lay leuell, was the
 -benefitting of my Countrymen, in whom I wish
 continual increase of knowledge and cunning, as
 in all other commendable professions, so chiefly
 in those that are most necessary and profitable.
 Thus bequeathing my travaile heerein to thy dis-
 creet construction, and wishing thy furtherance
 in this most necessarie and profitable knowledge,
 I leave thee to the direction of Gods holy Spirit.
 Fare-well.

Robert Norman,



THE



T H B

Magnes or Loadstones Challenge,

GIVE place ye glittering sparkes,
ye glimmering Diamonds bright,
Ye Rubies red, and Saphires brave,
wherein ye most delight.

In breefe yee stones enrich;

and burnight all with gold,

Set forth in Lapidaries shops,

for Jewels to be sold.

Give place, give place I say,

your beautie, gleame, and glee,

Is all the vertue for the which,

accepted so you bee.

Magnes, the Loadstone I,

your painted sheaths desie,

Without my helpe, in Indian Seas

the best of you might lye.

I guide the Pilots course,

his helping hand I am,

The Mariners delights in me,

so doth the Marchant man.

My vertue lies unknowne,

my secrets bidden are,

By

The Magnes or Loadstones Challenge.

By me the Court and Common-weale,
are pleased very farre.

No ship could sayle on seas,
her course to runne aright,
Nor compasse shew the ready way,
were Magnes not of might.

Blush then, and blemish all,
bequeath to mee thatts due,
Your seates in golde, your price in plate,
which Jewellers doe refuse.

Its I, its I alone,
whom you usurpe upon,
Magnes my name, the Loadstone call,
The prince of stones alone.

If this you can denie,
then seeme to make reply,
And let the painefull sea-man judge,
the which of us doth lye.

The Mariners judgement.

THE Loadstone is the stone,
the onely stone alone,
Deserving praise above the rest,
whose vertues are unknowne.

The Marchants verdict.

THE Diamonds bright, the Saphirs brave,
are stones that beare the name,
But flatter not, and tell the troath,
Magnes deserves the same.

THE

1

T H E

New Attractive.

C H A P. I.

Of the Magnes or Loadstone, where they are found, and of their Colours, Weight, and Virtue in drawing Iron or Steele; and of other Properties of the same Stone.

SOME **T**HE Magnes or Loadstone is found in divers Parts of the World, and most commonly in Yron Mines; and although it be ponderous and weighty, yet it is not found to be of the Yron Ewre, neither conteyneth in it any Mettal of it self, but hath a certain Affinity unto Yron or Steele. It was called *Magnes*, because the first Finder thereof was so named, who (as
B Plinie

Plinie writeth) was an Herdsman in *East India*.

This Stone (as writeth Cardinal *Cusan*.) hath Substance, Virtue, and Operation. His Virtue is conserved and nourished of his Substance : And of this Virtue proceedeth divers strange Effects and Operations, serving to many good Purposes, as specially in the Art of Navigation, without which there could have been no Discoveries by Sea, nor the Parts of the World made known and frequented as now they are ; and therefore the Virtue of this Stone, of all others, may be accounted the most precious.

Of these are divers Sorts differing each from other, as well in Goodness, as in Colour, Weight, and Force, but not in Property, (although many have judged the Variation of the Needle to be according to the Distance of the Mine where the Stone was bred, to the Place where he is used.)

The first and best Sort of these Stones come out of the *East India*, from the Coast of *China* and *Bengalia*, and is of the Colour of Iron, or Sanguine Colour. These Stones are very massive and weighty, and will draw or lift up the just Weight of it self in Iron or Steel, (if the Stone exceed not a Pound Weight.) And these are of the finest Sort, and are fold

fold commonly for their proper Weight in Silver in the *East India*, where they grow, because the best and finest are very rare to be found: For it is commonly a sole Stone, lying by himself in the Earth, and no Shell or Piece of another.

The best Loadstone.

There is another Sort, of a Reddish Colour, found in *Arabia* and the Red Sea, growing broad and flat, much like to a Tuffstone or Slate: This is not so weighty as those of *China*, but it is very near as good, and the Virtue continueth long on the Compass or Needle that is touched with it.

Next the best.

There is likewise of these Stones in *Levant*, in the Isle of *Elba*, hard by a Town in the same Island called *Porto Ferraro*, from whence our Mariners daily bring of them, and are called there; *Calamita Preta*, that is to say, the Black Magnet; because there is another Sort that is White and light, like unto a Piece of dry Fuller's Clay, and is called *Calamita Blanca*.

This *Calamita Blanca* is found always with the other, sticking fast in the Outside thereof like Clay. And this White is forbidden to be used in that Country, because evil Women there do apply it to destroy Conception; whereof this Stone is a great Enemy. Other things are noted of this White *Calamita*, for obtain-

ing of wanton Purposes, which I think not credible, and therefore will omit it. These Black Stones of *Elba* are mingled with White Veins; they are of no great Force, nor their Vertue of long Continuance.

Also there are of these Stones in *High Almains* that are full of Holes like an Honey-Comb, and lighter than the other, but yet very good: and these are of Iron Colour.

Another Sort there is in *Norway*, in the Iron Mines, as in *Longfoude*, and other
The worst. Places; their Colour is Black, mixed, or as it were interlarded with Grey: These are of the smallest Force of any that are found.

I have seen also in the Mines of *Carraxita* in *Spain* of a Grey Colour, but of no great Force. These are commonly brought by Horse down to *Sivill* and *Callis* to be sold; and oftentimes to *Valentia*, *Alicante*, and *Lisbon*.

All these Stones are different one from another, as well in Force, as in Colour and Weight; yet all of one Operation in the Needle, shewing one Point *Attractive*, as I have proved my self by three sundry Sorts of them, which I have; and all drawing Iron to them. Yet the Philosopher *Averroes* writeth, That the *Magnes* draweth not Iron unto it, but the
 Iron

Iron of his natural Inclination moveth to the Stone.

And though this Position may seem to carry some Truth with it, by the bare View of the Sight, when the Iron is lighter than the Stone; yet contrariwise you shall find that the Stone will move to the Iron, if the Stone be good, and the Iron of greater Weight than the Stone, (so that the Weight of the Stone exceed not his *Attractive* Strength.)

Nevertheless, we may not thereby take away the vital or lively Spirit from the Stone, and attribute it unto the Iron; for in so doing we should do Nature great Wrong. For it is apparent, that the Iron hath no *Attractive* Virtue nor Power of it self, until it have received it of the Stone. But Iron having a certain Affinity, or natural Quality agreeable to the Stone, doth aptly and freely receive his Virtue, and as a Subject, suffereth his vital Spirit of the Stone to impress, and rest quietly in his massive and solid Body; which when it hath received by touching the Stone, it is indued with the very same Property and Operations in all respects (though not in so great Force) as the Stone it self.

*The vitall
and natu-
ral Spirit
and Opera-
tion of the
Loadstone.*

For as the Stone hath Power to shew the *Attractive* Point, so hath the touched Iron: As the Stone hath two principal Points,

Points, so hath the Yron: And likewise, as the Stone hath Power to draw Yron to it, so will the Yron so touched, draw another Yron to it, and impart all these Virtues to another Iron in Quality, who not in Quantity: And thus in all respects it containeth in it the very Property of the Stone.

Paracelsus writing of the augmenting of the Strength of the *Magnes* Stone, saith, That if this Stone be laid in the Fire until it be almost red-hot, and then taken out and quenched in the Oil of *Croco Martis*, it will so augment and multiply his Force, that it will pull a Nail out of a Wall. But I suppose he meant not that the Nail should be fast, for then it were a miraculous Matter.

Others have written, that in those Parts, where the *Magnes* groweth in the Sea, it is of such Force, that if any Ships that have Yron in them pass by, or over them, that they are presently either stayed, or drawn down to the Bottom by reason of the Yron. Not these only, but many other Fables have been written by those of ancient Time, that have as it were set down their own Imaginations for undoubted Truths, and this most of all in *Geography* and *Hidrography*, or *Navigacion*. Therefore I wish Experience to be the Leader of Writers in those Artes,

Arts, and Reason their Rule in setting it down, that the Followers be not led by them into Errors, as oftentimes have been seen.

True it is, that God is mighty and marvellous in all his Works ; yet he doth not allow us to say more than Truth of them. And truly, his Power is as greatly shewed in the *Magnes*, as in any Stone that he hath created : And who so shall go about curiously to seek out the efficient Cause of his Properties, I suppose the longer he seeketh, the more he shall marvel, and yet never the nearer his Purpose.

The Vertue of the Stone is distributive, as many other Virtues are ; much comparable unto Musk, that having a sweet Savour or Smell it self, imparteth the same to another thing, as to a Pair of Gloves ; and those Gloves give out Savour, and perfume a whole Chest of Cloaths : Even so the Yron that hath received this Virtue of the Stone, will extend and give the same to another, and that Yron to another, and so to many.

And in this Point the Stone is marvellous, that notwithstanding you touch ten thousand Yrons or Nailes with him, every one of them carrying away as much Virtue as will lift up another his like, (so they exceed not the Weight of
a Six-

a Six-penny Nayle) yet the Stone it self will be nothing diminished of his Strength; but continue of one Force.

If I should say here, that by the *Attractive* Strength of a small *Magnes* of two or three Pound Weight, I could lift up, or cause to hang by the Virtue thereof, a thousand Pound of Yron at one Instant; peradventure you would be doubtful of the Success. Nevertheless, by Experience in all things, wherein consisteth Truth and Reason, of necessity Reason must yield, when Truth is present. And therefore, because you shall not remain doubtful herein, thus you may do it, and only make Proof by two or three Nails, if you will: for the same Success that you have in them, you shall have in all the rest.

Take a common Board Naile, and touch the Head of it with the *North* Parte of the *Magnes* or *Loadstone*; then take the same Nayle, and beat it with a Piece of Wood lightly into some Poste or Timber upwards, so as the Head may hang downwards, (but not with Yron, because the Yron will take away some Part of the Virtue from the Nayle.) This done, take another like Nayle, and touch the Head thereof with the *South* Part of the Stone; and then if you put the Head of it to the Head of the first Nayle, it will hang

hang fast by it a whole yeere or more. And after this manner you may, if you will take the paines, hang a hundred tun of Yron with the vertue of this little stone, and yet the stone nothing diminished of his force. But it is necessarie in prooffe of this matter, that ye have a very good stone.

Furthermore, concerning the other properties of this stone, if you put it in a dry dishe and sette it to swimme in a tub of Water, it will turne the dishe about, and the North parts of the stone, after many swaruings too and fro, will rest, and directly shew the line of *Variation*, or imagined *Attractive* point.

Irons to hang one by another by vertue of this stone.

Also, if you hang this Stone by a thrid, that it may easily mooue, it will shew the like effects as on the water. And if you haue two stones, putting the two South partes of them together, the one will fly and turne away from the other, and likewise of the North pointes.

And further yee shall note as a speciall point, that the North point of the Stone touching a Needle, or the wyers of a compasse, will make the same point touched to shew the South: and contrariwise being touched with the South point, will make the same to shew the North. So as alwaies that part of the stone that answereth to the north of the
C needle

A speciall note.

needle, is properly the South part of the Stone.



C H A P. II.

Of the diuers opinions of those that haue written of the Attractive point, and where they haue imagined it to be.

THE subtile properties and hid secretes of Nature in the *Magnes*, as also in diuers other things, hath so troubled the wits of the searchers thereof, thtt alwaies when they came to the upshot, wanting experience, and thereby reasons finger to shew them a direct marke, they were constrained to seek or imagine a marke, where indeed none at all was, and thus shooting as it were in the aire; every man where he thought best, they haue all shot wide, and none touched the marke. The marke I meane here, is the point *Attractive*, or rather, as shall be saide heereafter more at large, the point *Respectiue*.

This point aunciently called the *Attractive* point hath beene by some imagined to be in the mouing spheres distant from

from the poles of the world: which opinion *Martin Curtes* in his Book of Navigation refuting, saith, that if it were so, then the same point being carried about the pole by their violent motion, would cause the needle or Compasse touched with the vertue of the Stone, to varie daily in euery place, according to the diurnall motion of the same sphere. But in confuting the erroneous opinion, he hath (as it appeareth) fallen into as great an error himself: imagining the point *Attractive* to be beyond the poles of the world, without all the moueable heauens. Which point (saith he) hath power by *Attraction* to draw Iron to it, that is touched with the *Loadstone*. This error I referre to be discussed in the sixt Chapter.

Others haue taught this point to be in the earth, nere the North pole, imagining in that part to be some greate rocks of the *Loadstone*, and that by their *Attraction* the compasse or needle is caused to *Respect* or shew that part.

This opinion of all the rest is easiest to be confuted by daily experience: for if the compasse or needle were drawn towards the North part by any *Attraction* of the *Magnes* stones in those parts imagined, why then should not the Compasse or Needle shew the same effect in

moouing towards the Iland of *Elba* in the *Leuant* seas, where are great quantitie of these Stones? and yet Shippes sayling within a myle of this Iland, yea, and into *Porto Feraro*, a Towne of the same Ile, within a quarter of a myle of a huge Rocke of these stones, the Compasse or needle is not found any thing to be drawne or changed, nor the *Attraction* of this huge rocke to extend so farre as one quarter of a myle. And as I haue said by this, so may I say by diuers other places where the *Loadstone* are found in Cliftes and Mines neere to the Sea side, as in *Norway* and other places.

Pedro de Media, in his booke of Navigation, is of the opinion of *Martin Curtes*, as touching the *Attractive* point, but he doth not allowe of the variation of the compasse or needle, but saith, that if the compasse or needle shew not the pole, the fault is in placing the wiers on the flie, and not in any propertie it hath to vary.

These opinions be diuers, but the chiefeft cause why they have gone so farre wide from the *Attractive* point, as I haue aboue said, was because they wanted reasons fingers to shew them towards the direct marke. By this reasons finger, I meane a certaine *Declining* propertie under the Horizon, lately found in
the

the needle, which I will entreat of at large.



C H A P. III.

By what meanes the rare and strange Declining of the Needle, from the plaine of the Horizon was first found.

HAuing made many and diuers compasses, and using alwaies to finish and end them before I touched the needle; I found continually, that after I had touched the yrons with the Stone, that presently the north point thereof would bend or *Decline* downwards under the Horizon in some quantitie: insomuch that to the Flie of the Compasse, which before was made equall, I was still constrained to put some small peece of waxe in the South part thereof, to counterpoise this *Declining*, and to make it equall againe.

Which effect having many times passed my hands without any great regard thereunto, as ignorant of any such propertie in the Stone, and not before hauing heard nor read of any such matter: It chaunced at length

length that there came to my hands an Instrument to bee made, with a Needle of fixe inches long, which needle after I had polished, cut off at Just length, and made it to stand leuell upon the pinne, so that nothing rested but onely the touching of it with the stone: when I had touched the same, presently the north part thereof *Declined* downe in such sort, that beeing constrained to cut away some of that part, to make it equall againe, in the end I cut it too short, and so spoyled the needle wherein I had taken so much paynes.

Hereby beeing stroken in some choller, I applyed my self to seeke further into this effect, and making certayne learned and expert men (my friends) acquainted in this matter, they advised me to frame some Instrument, to make some exact tryal, how much the needle touched with the Stone would *Decline*, or what greatest Angle it would make with the plaine of the Horizon. Whereupon I made diligent proofes: the manner whereof is shewed in the Chapter following.



C H A P. IV.

*How to finde the greatest Declining of
the Needle under the Horizon.*

TAke a small Needle of Steele wier,
of five or sixe inches long, the
smaller and the finer mettall the better,
and in the middle thereof (crosse the
same) by the best meanes you can, fixe
as it were a small Axeltree of yron or
brasse, of an inch long, or thereabout,
and make the ends thereof very sharpe,
whereupon the Needle may hang leuell,
and play at his pleasure.

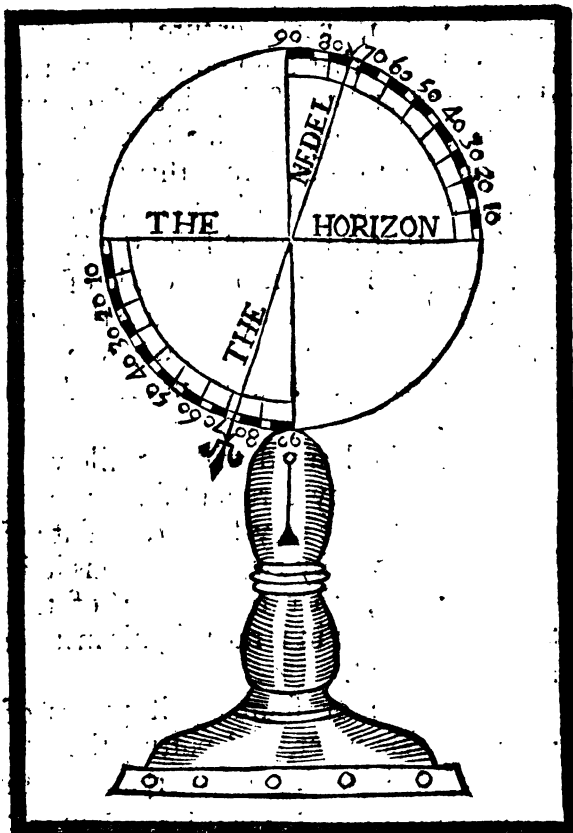
Then provide a round plaine Instru-
ment like an Astrolobe, to be divided
exactly into 360 partes, whose diameter
must be the length of the Needle, or
thereabout, and the same instrument to
bee placed uppon a foot of convenient
height, with a plumme line to sette it
perpendicular.

Then in the Center of the same In-
strument, place a peece of Glasse hollowed,
and against the same Center uppon some
place of Brasse that may be fixed upon the
foot of the Instrument, fit another peece
of Glasse, in such sorte that the sharpe
endes

endes of the Axeltree beeing borne in these two Glasses, the Needle may play freely at his pleasure, according to the standing of the Instrument.

And the Needle must be so perfected, that it may hang upon his Axeltree both ends leuell with the Horizon, or beeing turned, may stand and remaine at any place that it shall be sette : which being done, touch the saide Needle with the *Magnes* stone, and set the Instrument perpendicular by the plumme line, and turne the edge of the Instrument South and North, so as the Needle may stand duley according to the *Variation* of the place : which *Variation* the Needle of his owne propertie would shew, were it not that he is constrained to the contrarie by the Axeltree.

Then shall you see the *Declination* of the North point of the touched Needle, which for this Citie of *London*, I finde by exact obseruation to be about 71 degrees 50 minutes. The forme of the Instrument heere described with the manner of the declination, I have heere placed that it may be the easier conceived,



C H A P. V.

That in the virtue of the Magnes or Loadstone, is no pondrous or weightie matter, to cause any such declining in the Needle.

BEcause the opinions of men are divers, and the arguments of many
 D against

against reason, peradventure there are some will say, that I am deceived even in the ground and chiefeft point of this my purpose, alledging (as some have already done without reason) that this *Declining* of the needle is caused by some pondrous substance that it received from the Stone, and not (as I take it) proceede of the simple vertue and secret influence thereof, because the stone it selfe wherein the vertue remaineth and is nourished, is weightie.

I judge the learned will not allowe a Spirit to have any corporall substance or weight, or that it may sensibly be felt: if any should, yet by two conclusions it is easily proved, that the vertue of this Stone containeth in it no waightie matter: and thus found.

Take three or foure small peeces of yron or steele wyer, and putting them in a fine gold Ballance, counterpoise them justlie with Leade: Then take them out and touch them well with the stone, that they may receive the vertue thereof: And after weigh them againe in the same ballance, with the same leade, and you shall finde them to weigh no more then before they were touched, though every one of them have received vertue sufficient to lift up his fellow.

Secondly

Secondly, if the North poynt of the Needle do *Decline* by any pondrous or weightie matter, in the vertue received by touching the Stone, why then should not the South point of the needle, being touched with the contrary end of the Stone, have the same declining Southwardes, beeing all one Stone, and one vertue? Or why doth not this supposed heavier end, fall perpendicular to the Center, as by reason it should, and not covet a certaine scituation beside it, balancing it selfe up and downe, till it have found the same? These arguments may answer this matter. For touch the Needle with what part of the Stone you liste, that end of the Needle that sheweth the North will alwaies decline.



C H A P. VI.

A confutation of the common received opinion of the point Attractive.

SEing it is manifest that there is a Declining in the needle and that the same is not caused by any ponderous waightie matter in the vertue received from the stone; it may be demanded, by

what means this declining or elevating hapneth, in which of the two poynts consisteth the action or cause thereof.

Peradventure you will say (as other have imagined) that it is in the South point of the Needle, elevated by the *Attractive* vertue of some point of the Heaven that way. Perchaunce you will yeeld it rather to be in the North point of the Needle, which by some *Attractive* point in the Earth, or in the Heavens beyond the Earth that way, is drawne downe and caused to decline, and it *Declining*, of necessity the other South poynt opposite must needs be lifted up.

Your reason towards the earth carrieth some probabilitie, but I prove that there be no *Attractive*, or drawing propertie in neyther of these two partes, then is the *Attractive* poynt lost, and falsly called the poynt *Attractive*, as shall be prooved. But because there is a certayne point that the Needle alwayes respecteth or sheweth, beeing voide and without any *Attractive* propertie: in my judgment this poynt ought rather to bee called the point *Respective*.

And further if it may be proved, that there is no *Attractive* or drawing propertie in that poynt, the power and action in that poynt condemned, then of necessity the power and propertie, without
any

any external cause, remaineth only in the Stone and after in the needle, being touched with it, having the same power and propertie in it, that the Stone hath in every respect.

Now to prove no *Attraction* point neither beneath in the earth, nor Heavens Northwards; nor above in the Heavens Southwards, you shall take a peece of Yron or Steele wiew of two inches long or more, and thrust it into a peece of close Corke, as bigge as you think may sufficiently beate the wyer on the water; for as the same Corke rest in the middle of the wyer.

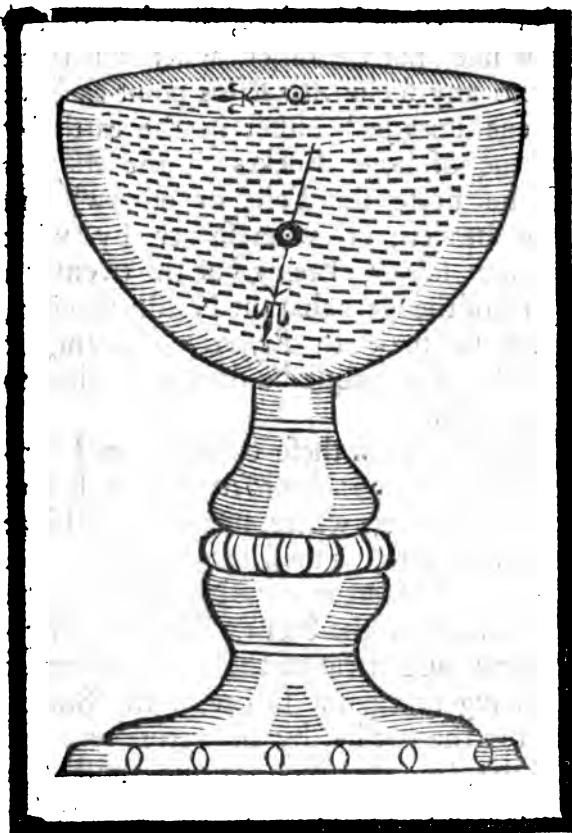
Then you shall take a deepe Glasse; Bowle; Cuppe, or other vessell, and fill it with fayre water, setting it in some place where it may rest quiet, and out of the winde. This done, cut the Corke circumspectly by little and little, untill the wyre with the Corke be so fitted, that it may remaine under the superficies of the water two or three inches, both ends of the wyer lying leuell with the superficies of the water, without ascending or descending, like to the beame of a payre of ballance beeing equalie poysed at both ends.

Then take out of the same the wyer without mooving the Corke, and touch it with the Stone, the one end with the South

South of the *Stone*, and the other end with the North, and then set it againe in the water, and you shall see it presentlie turne it selfe upon his owne Center, shewing the aforesay'd *Declining* propertie, without descending to the bottome, as by reason it should, if there were any *Attraction* downewards; the lower part of the water being neerer that point, then the superficies thereof.

And as this may proove no *Attraction* or drawing downewards in like manner the Corke being so made, that it may sinke very slowly to the bottome, and then taken out and touched with the *Stone*, and put in againe downe to the bottome with your finger, if any *Attractive* drawing were upwards, it would ascend, and come up to the superficies of the water, being neerer to that poynt than the bottome. But I finde by diligent and exact tryall, that it hath no such effect: as in the figure following is demonstrated.

Again,



Againe, if you doe fit your wyet
with Corke, that after it is touched with
the *Stone*, it will swim leuell in the
superficies of the water, you shall see
it turne to shew the true *Variation*,
and leaving the same in the middle of the
superficies of the water, so long as you
list, you shall finde that it will not bee
drawne

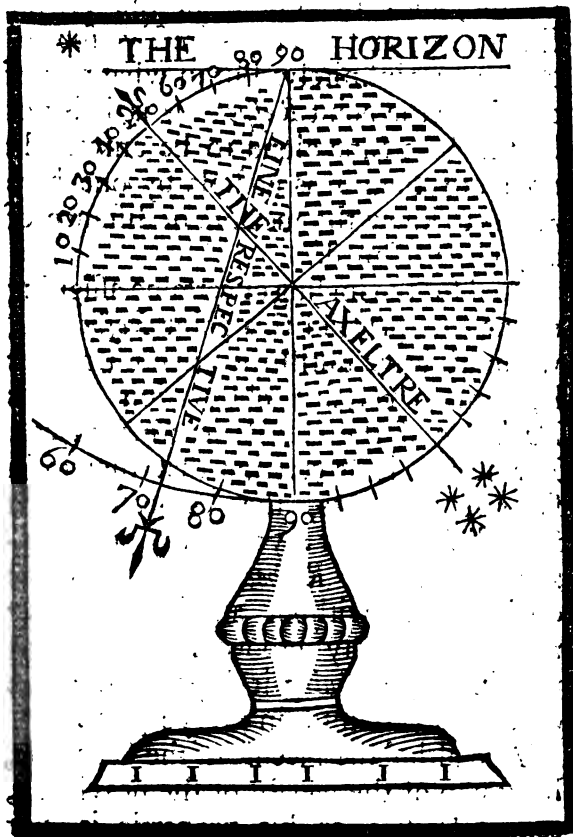
drawne from his place; neyther to the one side, nor the other, whereas if there were any suche *Attractive* point as have beene imagined, either in the earth by vertue of huge Rockes of the *Magnet* Stone neere the Pole, or otherwise in the heaven, or wheresoever, by what meanes soever, beeing but the twentieth parte of the force that the Needle touched, hath to shew to *Respective* poynt, it should of necessitie be drawne in time to some side.

So that upon these experiments I conclude, that the *Attractive* poynt before imagined, is no where, nor no such thing; and therefore, as most proper, I will call the poynt whereunto the Needle inclineth by vertue of the Stone, The point *Respective*, and attribute the whole power of shewing that point to bee in the Stone, and in the needle, by the vertue received of the Stone, which vertue must be imagined to bee turned, borne, and depending upon his owne Center, as shall bee shewed in the next Chapter.

C H A P. VII.

Of the Poynt Respective, where it
may bee by greatest reason imagined.

THIS Poynt *Respective*, is a cer-
tayne poynt, which the touched
Needle doth alwayes *Respect* or shew,



E

and

and is found by the declining of the Needle, to bee a pricke in some one parte of a straight-Line, declining in this place or Latitude of *London* under the Horizon 71 degrees, and 50 Minutes, as the Figure representeth.

This straight Lyne must be imagined to proceede from the Center of the Needle, into the Globe of the Earth, Extending, and going Directly foorth, both wayes infinitely. But in what part of this Line the point *Respective* is, it is not by this bare Line alone to be answered: no more then it is possible by one bare Angle to know the measure or distance of any place assigned.

And for the finding or certaine assigning of the true place of this point *Respective*, we must leave untill the expert travailer have made certaine observation of this *Declining* of the Needle in other places. For seeing it is certaine that though in severall Horizons, the compasse hath severall *Variations*: yet in any one Horizon the needle *Respecteth* alwayes one onelie point without alteration, as by travaile is truely proved. So I Judge, that in his *Declining* it keepeth the like order and certaintie in everye place.

And altho' the Needle of the Compasse, by reason of the weight of the heaue flie, cannot *Decline*, as his propertie is, but falselie

falselie sheweth the point *Respective* alwaies in the Horizon, as most necessarie so to doo for the Navigation: yet by the meanes and conclusions, which before I have shewed, the diligent traveller having with him a good *Magnes* or *Load-stone*, may by exact observation finde the increasing or decreasing of this *Declining* of the Needle, as the travelle shall give occasion.

For I am of this opinion, (and that by great reason) that this *Declining* of the Needle shall bee founde by travell to be great or little, according as the distance of the point *Respective*, is from the place where the triall is made: which beeing diligentlie observed in sundrie places, with the certaine *Variation* of the Needle from the Meridian, therby may bee demonstrated and found out the true place of this point *Respective*.

C H A P. VIII.

Certaine proofes that the power and action is wholie and free in the stone, to shewe this point Respective: and in the Needle, by vertue and power receiued of the Stone: and not forced or constrained by any Attraction in heauen or earth.

IT is most manifest in all the works of Nature, or Creatures that God hath made, that whatsoever Qualitie, Propertie, or Vertue is found in them, by Creation, that is to bee holden for theyr owne. And he that shall, by imagination or conjecture, go about to take these their Properties from them, and attribute the same to any other subject, whereunto they appertaine not: I say that man offendeth God much, for not beleeuing his Power to be sufficient in his Creatures.

I will not offer to dispute with the *Logitians*, in so many pointes as heere they might seeme to over-reach mee in Naturall causes. But that this stone hath wholly

wholy and fully in himselfe. Power, Action, Propertie and Vertue of his owne Appetite; to shewe; and to cause the Needle to shewe the point *Respective*, without any *Attractive* qualitie or external cause of Rockes of the *Magnets Stone*, or by *Attraction* in the Heavens, or elsewhere whatsoever, it is already sufficiently proved.

Notwithstanding, if these proofes may not content, I will at any time required heerein; satisfie the doubtful, by manifest Experiments. And therefore where no other cause can be probably annexed unto this Stone, the power and action of necessitie is proved in it selfe.

And by the *Declining* of the Needle, is also proved, that the point *Respective* is rather in the earth then in the Heavens, as some have imagined; and the greatest reason why they so thought (as I judge) was because they never were acquainted with this *Declining* in the Needle, which doubtlesse if *Martin Cortes* had knowne, hee would not have judged the *Attractive* point to have bene in the Heavens, or without them, but rather in the Earth.

Now peradventure you will aske mee howe this Stone hath his Power, and how it is engendred: I am no more able to satisfie you heerein, then if you should aske me howe and by what means the celestiaall

celestial Spheres are mooved: but that **G O D** in his Omnipotent providence hath appointed it so to bee; which may serve for a generall answer to all such curious searchers of the secrete woorks of God in his creatures. As though his Word alone were not a sufficiently Decree and law to all his Works: but binding then to second causes, as a thing of necessitie.

These curious searchers out of the secrets of Nature, further than is requisite that man should knowe for his necessary use, I may compare to *Esdra*, and with them to read over his fourth booke: and there they shall see how hee was answered at Gods handes by his Angel, for his curious Questions asked and demanded.

Nowe therefore, as I have before declared, that diuers haue whetted theyr wits, yea, and dulled them, as I have mine, and yet in the end have beene constrained to flye to the corner-Stone: I meane **G O D**: who (to conclude) hath given Vertue and power to this Stone, proper in it selfe, to shewe one certaine point, by his owne nature and Appetite, and not subject to any other accident in Heaven, nor in Earth, but freely by his owne proper vertue, receyved at his mighty hands in Creation: and by the
same

same vertue, the Needle is turned upon his owne Center, I meane the Center of his Circular and invifible Vertue, piercing all thinges, and ftayed by nothing, be it Wall, Boorde, Glaffe, or any thing whatfoever.

And furely I am of opinion, that if this Vertue could by any meanes be made vifible to the Eye of man, it would be found in a Sphericall forme, extending rounde about the Stone in great Compaffe, and the dead bodie of the Stone in the middle thereof : Whose center is the center of his aforefaid Vertue. And this I have partly proved, and made Vifible to be feene in fome manner, and God fparing mee life, I will heerein make further Experience, and that not curioufly, but in the Feare of God, as neere as he fhall give mee grace, and meane to annexe the fame unto a Booke of Navigation, which I have had long in hand.

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CHAPTER IX.

Of the Variation of the Needle, from the Pole, or Axeltree of the Earth; and how it is to be understood.

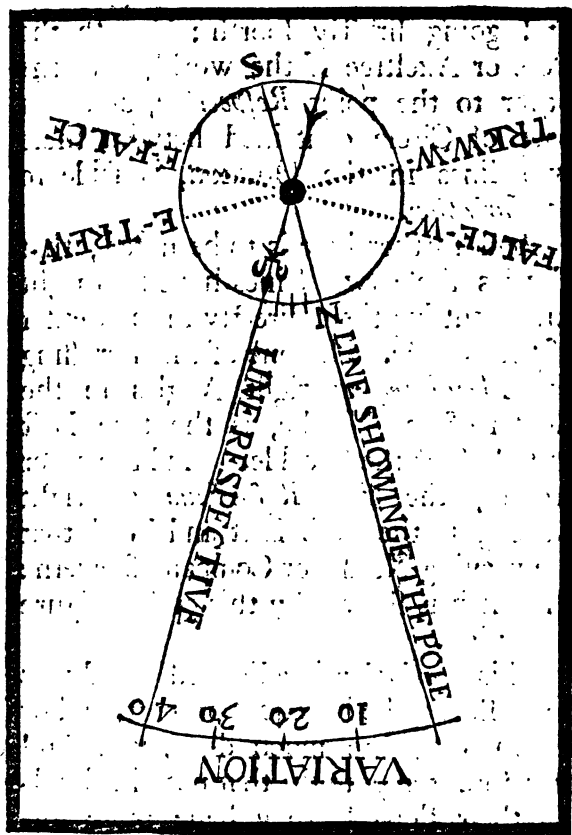
NOW, as the Needle hath this apparant propertie in *Declining* under the Horizon, to shewe the point *Respective*: So it is most manifest, that as in *Declining* it hath property in varying, or departing from the Poles, even as the point *Respective* openeth or sheweth a greater, or lesser distance betwixt the sayde poynt *Respective*, and the Pole or Axeltree of the Earth. And this departing is called *Variation* of the Needle. This is also shewed in the Needle or Wyer, in that conclusion of declining in the Water, as in the sixt Chapter, even by the same proportion, that it sheweth in the needle Horizontally.

This *Variation* is no other thing, then a certaine parte or portion of a Circle, contained betwixt two straight lines proceeding both from one Center, which may be imagined to be the Center of the Needle, and from thence both extending
and

and going directly forth : One to the Pole or Axeltree of the world, and the other to the point *Respective*, and this part of Circle contained betwixt these two lines in the Horizon, is saide to be *Variation*.

And further here is to be noted, that alwaies these two Lines have two right Lines, cutting them directly in the Center of the Needle. The one of them crossing the *Meridian*, at right Angles in the Center of the Needle, is the true East and West of the Worlde. And the other crossing the line *Respective* at right Angles, is the false East and West that the varying Needle or Compasse sheweth : all which is shewed by this present figure following.

This *Variation* is adjudged by divers Travellers to be by equal proportion, but herein they are much deceyued: And therefore it appeareth, that notwithstanding their Travell, they haue more followed theyr Bookes then Experience in that matter. True it is, that *Martin Curtes* doth allowe it to bee by proportion, but it is a moste false and erroneous Rule. For there is neither proportion nor Uniformity in it, but in some places swift and sudden, and in some places slowe.



It is said to be proportional or uniform, when in the increasing or decreasing of a degree of Variation, is found one certaine number of Leagues or Myles, going, increasing, or decreasing, in one Parallel or Latitude, by like equal proportion, and that if the Variation be doubled, going by one Parallel,

to shall the leagues or miles also. But this is not found to be so.

For in going from *Silly* to *Newfound-land*, which is not 600 Leagues, it is found that the Needle doth varie more in 200 Leagues, when you come neere that Countrey, then it doth in 400 Leagues of your first way. And also going to *Meta Incognita*, it varieth more in parte of the last of the way, then in 3 parts of the first, and in those partes it is found to be suddaine. Further it is found betweene the *North Cape* and *Vai-*

gatz very strange, in recoyling and comming backe againe to the Westwardes of the Pole, before it hath fully accomplished two poyntes of Variation in the compasse. So that at *Vaigatz* it varyeth to the Westwards, as it doth at *Newfound-land*. And this comming backe againe, before it hath accomplished foure poynts of the Compasse, is very strange, and against the opinions of all that have before written.

Pedro de Medina (as I have said in the second Chapter) was doubtfull of the Variation, saying: that if the Compasse did varie, the fault might bee in the making thereof, the Wyers or Needle not being well placed: yet hee was a Learned man, and a great Traveller to the West Indies. But it appeareth that

he had no more regard to the Variation, then many Mariners in these dayes.

For in 18 or 20 years that I haue trauelled the Seas, being daylie conuersant with many of them, and diligent in Enquiring of Variation of the places, where I have not been my selfe, I could never finde two of them in one trueth, except for the Trauailes from hence Northwards and North Eastwardes. But I suppose, the greatest Occasion thereof is by lacke, of exacte Instruments for that purpose. Wherefore I have devised one very necessarie.

And further, because this Variation is diuers, and is found sometimes to the Eastwards, and sometimes to the Westwards of the Pole, I will declare what the Variation is here in *London*, by mine owne obseruation, and in other places, as I haue grossely gathered of some Travelers, reckoning, or beginning at the ancient bound or great *Meridian*, that passeth by the Isle of *Saint Michaell* in the *Açorres*: where it is saide, that the Needle sheweth directly the Pole, and the *Respective* point both in one line. But this is not found to be so.

True it is, that the North poynt of the common Compasse, sheweth the Pole very neere in that *Meridian*, but the bare Needle sheweth about 4 Degr. 50 Min.

to

to the Eastwards of the Pole. So that you must understand alwayes the difference betweene the common Compassse and the Needle, to be at the least 1 third part of a point, and of some more; because the greatest parte of the common Sayling Compasses, hath the Needle set in the Flye, half a poynt, or 2 third parts, to the Eastwards of the North, and some 3 quarters of a poynt, and others at a whole poynt; and some againe, are set directly under the Flower-de-Luce, or North of the Compasses: those are called *Meridional-compasses*, because they shewe directly the Pole, in the great *Meridian*: as the bare Needle doth, which *Meridian* must needs be at the least an hundred, or an hundred and twenty Leagues to the Westwards of the He of *S. Michaell*.

And therefore to write of the Variation of places, by the common Reportes of Maryners that have travelled Southwards and Westwardes from hence, it shall be as uncertaine, as are the divers makings of these common Compasses, by which they haue made their Obseruations. And therefore I will omit it, and speake only of this place or Citie of *London*, whose Latitude I finde to be 51 degrees, 32 min. and the Variation of the Needle

Needle from this *Meridian* of the Pole to be 11 Degrees, 15 Minutes.

And although this Variation of the Needle be found in Travell to be diuers and changeable, yet at any Land or fix-ed place assigned, it remaineth alwayes one, still permanent and abyding. And therefore I wisth the Marryner to make diligent obseruation of this Variation in diuers places, as he shall Travell, by some exact Instrument for the purpose. For it may be greatly for his aide, against he come there another time, especially in such places where the Variation is swift, as in these North parts. And because the common Compass is partaker of this Variation and Declining, as the Needle is, I will somewhat shew of the sundry sorts and makings of them, with the inconueniences that may grow by them, and by yll plat, made by these diuers sortes of Compasses.

C H A P. X.

Of the common Compasses, and of the divers different sortes and makings of them, with the inconveniences that may growe by them, and the Plats made by them.

OF these common Sayling Compasses, I finde heere (in *Europa*) five sundry sortes, or sets. The first is of *Levant*, made in *Scizile*, *Genoia*, and *Venice*: And these are all (for the most parte) made Meridionally, with the Wyers directlye sette under the South, and North of the Compass: And therefore, duely shewing the poynt *Respectiva*, in all places, as the bare Needle. And by this Compass are the Plats made, for the most part of all the *Levants* Seas.

Secondly, there are made in *Danske*, in the Sound of *Denmarke*, and in *Flamden*, that have the Wyers set at 3 quarters of a point to the Eastwards of the North of the compass, and also some at a whole point: and by these Compasses

passes they make both the Plats and Ruters for the Sound.

Thirdly, there hath beene made in this Countrey particularly, for Saint *Nicholas* and *Russia*, Compasses set at 3 seconds of a point, and the first Plats of that Discoverie were made by this Compassse.

Fourthly the Compassse made at *Sevill*, *Lisbone*, *Rockell*, *Bourdeaux*, *Roan*, and heere in *England*, are moste commonly set at halfe a point: And by this Compassse are the Plats of the East and West *Indies* made for their Pylotes, and also for our Coastes neere heereby, as *France*, *Spayne*, *Portugall*, and *England*: and therefore best of these Nations to bee used, because it is the most common sorte that is generally used in these Coastes, And againe, it is saide, that the Middle hazard is best.

I speake thus, because there are so many sortes of these Compasses different each from other, as before I have declared. And the Mayster or Maryner Sayling by these Compasses of sundry sorts, may thereby fall into great perill, and the reason is, because that of long time these Compasses haue been used, and by them the Marine Plats haue bene described of sundry sortes, every one according to the Compassse of that Countrey.

If

If then he take not the Compasse of the same setts or making that the Plat was made by, then his Carde or Plat will shewe him one Course, and the Compasse when he thinketh he goeth well, will carry him another way. And thus, when he thinketh to fall with the Place that his Carde sheweth him, he shall be as farre wide, as the Compass he hath Sayled by, is different from that his Plat was made by.

This is the ground and cause of many inconveniences, which is now too late to be generally reformed : Therefore I wish the Mariner to have a great regard unto this, as a principal poynt in Navigation, and not to Sayl by a Compasse of one parish, and a Plat of another : I meane that they have a respect, as near as they may, to Sayle by a Compasse of that countrey, where his Plat was made.

Yet many there are that use our Compasse with *Levant* Plats : but I suppose without good Consideration therein, they shall make but wide reckonings. And this hath bene sufficiently of late experimented, by our Mariners that have used *Levant*.

Peradventure there are some will say, that he knoweth a good Compasse, if he see it ; I say the Compasse may be good, and yet not good for him, except his

G

Plat

Plat be agreeable : As for Example : A *Levant* Compasse is a good Compasse, to use with a *Levant* Plat, but it differeth from our Compasse halfe a point more Easterly, And others there are of *Danske*, that differ from ours 1. halfe point more Westerly, and yet being used in their kinde, are good Compasses.

And therefore I conclude, that generally the best Compasse is this sorte set at one halfe point, because the major parte of Compasses and Plats doth not differ from this above one quarter of a point : except the two abovenamed, *Levant*, and *Danske*.

I have heard many say, that have travelled farre to the Southwardes, that the Compasse hath seemed to loose his Force, and to waxe weak and Dull. I judge the cause is not by reason of the farre distance from the North-Pole, but rather by beeing long absent from the Stone: for not being touched or refreshed therewith. And againe, the Pinne that beareth the Flye, may be so dulled with long using, that the Flye is as it were stayed, that it cannot play as it would, if it were sharpe.

Therefore, if you make it sharpe with a whet-stone, you shall finde it remedied, And also when you finde it light, or too Tickle, you may dull the poynt of the
the

the Pinne, with the leafe of payr of Wrying-Tables, untill you may see the toppe thereof : and then the Compasse will bee better for a high-Sea. And thus by sharpening and dulling of the Pinne you may make your Compasse fitte for all Weathers.

F I N I S.



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N. B. **E**VERY Author of a Dissertation on the Subject proposed, writes some Motto or Sentence at the bottom of his Dissertation ; and also sends his Name and Titles, together with the same Motto, sealed up. The Academicians first examine all the Dissertations without knowing their Authors, and when they have adjudged the Prize to any one of the Dissertations,

(6)

tions, they open the sealed Papers to find out the Author, whose Name has along with it the Motto of the Paper winning the Prize.



N. B. *For the sake of such Persons as are curious to know what Electrical Experiments have been made ; those Places in the Philosophical Transactions of London, and in the Memoires of the Royal Academy of Sciences of Paris, and other Treatises concerning this Subject, are referred to, where the Experiments are described at large.*

100



A

DISSERTATION

CONCERNING

ELECTRICITY.

ELECTRICITY is a Property of some Bodies, whereby they alternately attract and repel small Bodies when brought near them, and that at sensible Distances, *viz.* from a quarter of an Inch to the Distance of two or three Foot, and sometimes beyond.

The first kind of Bodies in which this Virtue or Property has been observed is the *Electrum* or Amber, for which Reason it has been called *Electricity*, which Name has been retained, tho' the same Virtue has been observed in a great number of other Bodies; as for example, in all sorts of Glass, Crystals, and precious Stones; Resins, Sulphurs, and

B

some

some Minerals ; dry animal Substances, and Vegetables (tho' rarely) but never Water and watery Fluids, moist Bodies, and Metals.

The Electricity which is inherent in several Bodies is hardly perceptible, unless they have a vibratory Motion given to them, by Friction or any other Means, so as to cause them to throw out *Effluvia* or Emanations.

I distinguish all Bodies into such as are *Electricks per se* (or of themselves) and *Non-Electricks per se*. A Body that is *electrick per se*, is such an one in which Electricity may be excited by some Action upon that Body, such as rubbing, patting or warming it, and sometimes only exposing it to cold and dry Air after it has been covered, &c. A *Non-Electrick per se* is a Body which cannot be excited to Electricity by any Action upon the Body itself. But yet *Non-Electricks per se* receive Electricity, when you bring near them *Electricks per se* in which Electricity has been excited. In order to know, that Non-Electricks have received the communicated Electricity, they must be *insulated*, that is, they must not be suspended from, or supported by any Bodies but what are *Electricks per se*; for if a Non-Electrick be touched
by

by another Non-Electrick, which touches a third, and so on ; all the Electricity received by the first will go to the second, and from the second to the third, and so on, till at last it be lost upon the Ground, or the Earth. But if several Non-Electricks touching one another, are at last terminated by Electrick Bodies, in that respect they make but one Body, and receive and retain Electricity for some time.

There are several ways of finding when Non-Electricks have received Electricity, (which is generally communicated to them by applying a Glass-Tube, excited by Friction, to one End of those Bodies) of which here follow a few. If an Iron-Bar be suspended horizontally by two silken Strings that are very dry, and the rubb'd Tube be applied or brought near to one of the Ends of the Bar, and then some Leaf-Gold or Leaf-Brass, or any other light Bodies plac'd upon a small Stand be brought near the other End, they will be alternately attracted and repell'd by the Bar. Likewise if you bring your Face or the End of your Finger near the said End of the Bar ; the electrical Effluvia coming out on the sudden will make a sensible Prick-

ing, with a snapping Noise, and produce a Flash of Light that may be seen in the dark. A small flaxen Thread about a Foot or two long, suspended by a Stick, and being brought near the Bar, will be attracted by it without destroying its Electricity till after some time. That Thread (which we shall call *the Thread of Tryal*) serves to find out when the Bar or any other non-electrick Body has receiv'd the communicated Electricity.

A Body which is *electrick per se*, does not receive this Virtue from another *electrick per se* tho' excited, till it is become a *non-electrick*; which happens when it is made moist; and then it will be made electrick only by Communication. So that an *electrick per se* may become *non-electrick*; and likewise a Body *non-electrick per se* may become electrick by Communication.

Those electrick Bodies in which it is difficult to excite Electricity, may be look'd upon as *Non-Electricks*, when their Electricity is not excited: and then they will be in the same Condition as *Non-Electricks per se*, and be liable to receive Electricity by Communication in the same manner.

As there are a very great number of electric Bodies, which act after the same manner when Electricity has been excited in them, I shall here mention only the Tube of Glass which is rubb'd by the Hand, referring my Reader for the Enumeration of other electric Bodies, and their Effects, to the late Mr. *Harvee's* Book of Physico-mechanical Experiments, to the Philosophical Transactions of *London*, to the Memoirs of the Royal Academy of Sciences at *Paris*, and to the other Authors who have written upon this Subject.

The Glass-Tube commonly us'd in electrical Experiments is about three Foot and an half long, an Inch and an half in diameter, and about $\frac{1}{4}$ of an Inch thick, open at both Ends, but sometimes hermetically seal'd at one End, viz. that which is furthest from the Hand. These Proportions are not strictly necessary: only this Bigness is most convenient for the Hand; and when the Thickness is less than $\frac{1}{4}$ of an Inch, the Electricity is sooner excited by Friction, but it does not last so long as when the Tube is thicker. You must hold the open End of the Tube (when it has one End shut) in the left Hand; and it
must

must be rubb'd up and down several times with the right Hand, holding dry Paper or dry Clóth in your Hand: but the Hand alone is much better, provided it be very dry, which seldom happens. It is also very proper to warm the Tube a little by the Fire to dry it before you begin to rub it; but absolutely necessary to do it when the Air is moist, which is the most inconvenient Weather for making these Experiments. Dry and cold Air is the most proper, for then very little Friction is sufficient; but you must rub the Tube a great while, and the Electricity continues but a little while when the Weather is moist.

To know whether the Tube has been rubb'd long enough, and the Electricity sufficiently excited, you must strike your Fingers cross-wise near the Tube, but without touching it, at the Distance of about half an Inch, and you will hear a snapping from the electrical Effluvia, which going from the Tube strike against the Fingers and rebound again to the Tube. Then you may be sure that the Tube is in a Condition to produce its Effects, being fully prepar'd for making electrical Experiments; but you must not forget

forget to rub the Tube anew (at least once) after it has been made to snap in passing the Fingers near it : because at the Place where the Fingers pass'd by and made a snapping, the Electricity of the Tube has been destroy'd. If you move your Fingers long-wise from one end of the Tube to the other (but all the while without touching it) you will hear a continued snapping, like a distant Noise of Thorns burning in a Fire. If the Room be darken'd when you make these Experiments, you will see Sparks of Light where-ever the Tube snaps ; and likewise a Light following the Hand that rubs the Tube.

Some EXPERIMENTS made with the Tube above describ'd, sufficient to shew the Manner in which the Bodies which are electrick per se, act.

AS 'it wou'd require a whole Volume to recount all the electrical Experiments that have been made, and those that are made every day ; I shall only mention here some of the most remarkable Experiments which will
serve

serve to explain the Principles that I lay down ; by which one may always certainly foretell what will happen to any Body which is excited to Electricity, or any other Body which receives the Electricity communicated from a Body in which Electricity has been excited.

EXPERIMENT I.

Having laid small Pieces of Leaf-Gold or Leaf-Brass, or any other small Bodies upon a little Stand whose Surface or Top was seven or eight Inches Diameter, the rubb'd Tube having been brought within a Foot or two of the Stand, the small Bodies were alternately attracted and repell'd for some time ; and sometimes they were repell'd from the Tube as they were coming towards it, even before they had touch'd it, and also came back from the Stand towards the Tube without having touch'd the Stand, jumping backwards and forwards with great Swiftneſs.

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EXPERIMENT II.

Having tied a Down Feather to the top of a wooden Broach or Skewer of about six or seven Inches in Height, and fix'd upright upon a Foot; when you bring the excited Tube near it, all the Fibres of the Feather stretch out towards the Tube; but as soon as you remove the Tube, the Fibres of the Feather turn back and stick strongly to the Skewer. If you bring your Finger near to the Feather while its Fibres are tending towards the Tube, being attracted by it, the Finger will repel them; but as soon as you remove the Tube, they are attracted by the Finger. If you cover the Feather with a Glass Recipient (such as are us'd on the Air-Pump) that is very dry, the Tube will attract the Feather in the same manner thro' the Glass: and this happens even when the Recipient has been exhausted of its Air by the Pump. When the Tube is rubb'd near the Recipient, whether it be full of Air or empty, the Fibres of the Feather follow the Motion of the Hand along the Tube, rising and falling upon the Broach or Skewer.

EXPERIMENT III.

Without making use of the Tube, if you rub the Recipient that covers the Feather, with both Hands, the Fibres of the Feather will stretch themselves out towards the Glass like the Rays of a Sphere. If you rub but with one Hand, the Fibres will stretch themselves towards that Part of the Glass which is rubb'd: and then when you blow against the Glass, those Fibres will be repell'd notwithstanding the Interposition of the Glass; which happens also when you strike the Air with the Hand towards the Feather without touching the Recipient.

EXPERIMENT IV.

After the Tube has been rubb'd, if any Assistant lets go a Down Feather in the Air at the Distance of a Foot or two from the Tube, the Feather will jump towards the Tube with an accelerated Motion, and adhere to it for some time; and then of a sudden it will be repell'd from the Tube, and will fly about in the Air in such manner, that the
nearer

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nearer you bring the Tube to it, the more it will be repell'd, till it has touch'd some other Body; and then it will be drawn again by the Tube; which after some time will drive it away again. Sometimes when the Finger is held at eight or ten Inches from the Tube, the Feather will jump from the Tube to the Finger and from the Finger to the Tube thirty or forty times together.

EXPERIMENT V.

If a String of any kind be stretch'd horizontally, and from that String you hang a Thread of Silk about three Foot long and very dry, and to the lower End of that Thread you fasten a Down Feather; then at the Distance of about two or three Feet hang up another Feather, but by a flaxen Thread; the rubb'd Tube being brought near will attract the first Feather, which, when it has adher'd to it a little while, will fly from the Tube, and then be repell'd by it every time the Tube is brought near, till it has touch'd some other Body, as in the Fourth Experiment; and then it will be attracted anew. But the Feather which is suspended by the flaxen Thread will

always be attracted at the Approach of the Tube, and never repell'd. N.B. *If you wet the silken Thread, the Feather hanging at it will be repell'd no more, but always attracted by the Tube.*

EXPERIMENT VI.

When the excited Tube is brought near your Face, you will feel the electrick *Effluvia* like small Hairs which will strike your Eyes and Cheeks, draw the Hairs of your Eye-brows, and make a small crackling Noise.

EXPERIMENT VII.

If you make use of a Tube which is hermetically seal'd at one End, and has at the other End a Brass Ferril with a Screw, by which means you may pump out the Air from it: If you rub the Tube after you have exhausted the Air, it does not attract any more, nor give any Light outwardly; but it gives much more Light within. Then if, by opening the Cock a little way which is fastened to the Tube, you let in the Air slowly whilst

whilst you rub the Tube, the Light diminishes, and being interrupted by the Air as it comes in, looks like Lightning at a Distance, till all the Air is come in, and then there is no more Light within; but the Light goes all to the Outside, and the Attraction returns.

EXPERIMENT VIII.

If upon the Stand mention'd in the First Experiment you set up edgewise two little Boards about nine Inches long, six Inches wide, and three quarters of an Inch thick (two small Octavo Books will do as well) parallel to each other, and about the Distance of ten Inches asunder; little Pieces of Leaf-Gold or Brass laid upon the Stand between those Boards, will not be attracted by the rubb'd Tube held near them, till it be brought quite between the said Boards, as near to the Stand as half the Distance of the Boards from each other: that is, when the Tube is so held that a Circle describ'd round the Axis of the Tube with the Distance that is between that Axis and the Stand, passes between the Boards or Books without touching them.

them. But when the rubb'd Tube being held horizontally at the Distance of a Foot from the Stand, seems to have no Virtue, because the Leaf-Gold has no Motion; if an Assistant snatches away the Boards all on a sudden, the Pieces of Gold will be attracted and repell'd several times, without giving any new Friction to the Tube.

EXPERIMENT IX.

When the Air is very dry, and the rubb'd Tube can attract the Leaf-Gold laid on a small Stand, to the Distance of three Foot or beyond; if the same Leaf-Gold be laid upon a Table or any large Surface, you must bring the excited Tube very near before it can produce its Effect.

EXPERIMENT X.

When the Air is moist, the fourth Experiment does not succeed well; for after the Feather in the Air has been some time driven about by the Tube, it comes back of itself to the Tube without having touch'd any other Body; and sometimes after having adhered

to the Tube towards the middle of it; it flies off of it and comes again immediately to the Tube, sticking to that Part of it which is farthest from the Hand. It happens also, when it is very dry and the Tube repels the Feather, (after having attracted it) to the Distance of two or three Foot ; that if you wet the Top of the Tube at the End for the Length of six or seven Inches, the Feather will come and stick to that End of the Tube without having touch'd any other Body,

EXPERIMENT XI.

Having fill'd with Water a small Drinking-Glass of about an Inch Diameter, when you bring the rubb'd Tube near it, the Water rises in a little Hill accumulated at the Edge of the Glass, sometimes jumping towards the Tube in a little Jet, so small that you can hardly see it, tho' you may find the Tube wholly wet with it. One may also observe that this accumulated Water rises in the Shape of a small Cone whose Axis is sometimes stretch'd out horizontally towards the Tube, then snaps and falls down again flat upon the rest of the Water. If this Experiment be
made

made in the dark, a Flash of Light accompanies the snapping.

EXPERIMENT XII.

If by means of an artificial Fountain (in which Air is condens'd upon the Water to make it spout) you play a small Jet of about the 40th part of an Inch Diameter, upwards or downwards: the rubb'd Tube being brought near, the Jet will bend towards the Tube at the Distance of a Foot; and if the Tube be brought nearer, the Jet being wholly drawn away by the Tube, is chang'd into a Dew upon the Tube, so that it adheres to the Tube in little Drops, provided the Jet be not made to spout with too much Force.

Here follow some remarkable Effects of Electricity communicated to Bodies which are Non-electricks per se,

EXPERIMENT XIII.

Having stretch'd horizontally a Packthread or hempen String to the Length of about twelve hundred Foot, at the End of which
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was suspended an Ivory Ball of about an Inch and an half in Diameter ; this Ball has drawn and repell'd Leaf-Brafs or Leaf-Gold when the rubb'd Tube has been brought near the other End of the String : the Thread of Tryal being also brought near to the said Ball was attracted by it.

N. B. *All the Supporters of this String must be Electricks per se, whether they be Hair-Ropes, Fiddle-strings, or Cat-guts, Ribbons, Strings of Silk, Glass Tubes, long Bodies of Sulphur or of Resin, &c. and all those Bodies very dry. We shall hereafter call the non-electrick Body, which being stretch'd out in length, receives the communicated Electricity, the Conductor of Electricity ; and the Bodies on which it rests, or from which it is suspended, the Supporters of the Conductor of Electricity.*

EXPERIMENT XIV.

If you wet the Conductor of Electricity, the Experiment will succeed the better ; but you must take care not to wet the Supporters : for if the least of the Supporters, for

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example the first, be wet, it becomes a *Non-electrick*, and thereby conducts the Electricity that comes to it to the Body which it touches, and from thence to the Ground, where it is lost, not suffering it to go any farther upon the Conductor. If you examine the Supporters by bringing the Thread of Tryal near them, you will find them to be electrick about five or six Inches on each side of the Conductor, more or less as the Air is more or less moist; the Supporters being as it were saturated with the communicated Electricity in a little space near the Conductor.

EXPERIMENT XV.

If instead of stretching the Conductor at length, you carry it backwards and forwards upon the Supporters several times in parallel Lines, provided those Lines be distant enough from each other (for example about three Foot distant) the communicated Electricity will run as far backwards and forwards as if the String had gone straight on, and will give as much Virtue to the Ball at the End of the Conductor.

EXPERIMENT XVI.

If the Conductor is stretch'd out in the form of a Star, the electrical Virtue will be perceiv'd at all the Points of it. For example, if the Conductor be stretch'd from the first Supporter about forty Foot in length, and then divided into five Branches of twenty Foot long each, separated from each other in the manner of a Star, with a Ball at the End of each String or Point; when you bring the rubb'd Tube near the beginning of the Conductor; you will find by Threads of Tryal that all the Balls have receiv'd the Electricity at the same time,

EXPERIMENT XVII.

Having supported, or suspended by electrick Bodies, an Iron-Bar nine Foot long, which had three Branches pointed at the End at the Distance of two Foot from each other, the Electricity communicated from the Tube at the other End, was felt at the same time by the Cheeks of three Persons which brought their Faces near the three Points, by a snap-

ping Noise, a Pricking, and a Flash of Light seen in the dark.

EXPERIMENT XVIII.

Having suspended a Man horizontally (as in a swimming Posture) by two Hair Ropes, that Man becomes a Conductor of Electricity. That which he receiv'd by the Approach of the rubb'd Tube brought near the Soles of his Feet, made him strongly attract the Thread of Tryal and Leaf-Brass with his Head and his Hands; and likewise with his Feet, but very weakly. But when the Tube is brought near his Head, then his Feet attract very strongly. Then if the Man (when the rubb'd Tube is brought back to his Feet) holds out his Finger near the Face of any Person standing by, a Flash of Light will fly from the Finger, a snapping Noise will be heard, and both the Man on his Finger and the Assistant on his Cheek will feel a Pricking at the same time. In the same manner, if any one moves the Hand cross-wise near the Arms or Legs of the Person suspended, they will both feel the same Pricking; and if one puts an Iron-Bar near the Person suspended, he

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will

will hear the Snapping and feel the Pricking. What is remarkable is, that if the Man hanging horizontally has on a Cloth Coat that is quite dry, you will feel no pricking when you pass your Fingers near the Coat, and the Thread of Tryal will be but weakly attracted by it, nay sometimes not at all.

N. B. *Any other Animal suspended will produce the same Effect.*

EXPERIMENT XIX.

The Electricity receiv'd by the Conductor advances from one End of it to the other in a kind of Cylandrick *Vortex*, as may be seen by the following Experiment. Having carried a Packthread Conductor of Electricity thro' the middle of a wooden Hoop fix'd vertically upon an open Glas Cylandrick Recipient, its Plane being at Right-Angles with the Packthread: when you bring the rubb'd Tube near to one End of the Packthread, not only the Ball at its other End becomes electrick, but also the whole Circle or Hoop tho' six Foot distant from the Ball; for the said Hoop attracts the Thread of Tryal by all its Parts.

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EXPERIMENT XX.

Having suspended the before-describ'd artificial Fountain, by Fiddle-strings, and having open'd its Cock to make its Jet play, horizontally, or obliquely, or vertically upwards; if the rubb'd Tube be brought near the Body of the Fountain, the Electricity will be communicated to the whole Jet, which will then in every part of it attract the Thread of Tryal; the Jet becoming then a Conductor of Electricity.

EXPERIMENT XXI.

If you suspend two or three Iron-Bars in the same horizontal Line, at the Distance of six Inches from one another, the Electricity communicated by the rubb'd Tube to the End of one of the Bars will go on from the one to the other quite to the End of the last Bar, where a Pricking will be felt, a Noise heard, and a Flash of Fire seen. If the Air is dry, the Electricity will jump from one Bar to another at a greater Distance; but in moist Weather

Weather the Bars must not hang above an Inch distant from each other.

EXPERIMENT XXII.

Having by a Fiddle-string suspended a Bough of a Tree which had about four or five hundred Leaves, upon the Approach of the rubb'd Tube all the Leaves attracted the Thread of Tryal. Then having stretch'd a Rope from that Bough to another suspended in the same manner at the Distance of thirty Foot from the first: the Tube brought to one of the Boughs gave Electricity equally to the two. Afterwards substituting a very small flaxen Thread, instead of the Rope, from one Bough to the other; the Electricity was communicated as easily as before.

EXPERIMENT XXIII.

When a small String of white Silk of about the same Size as the flaxen Thread, was stretch'd from one Bough to the other, the Electricity communicated to one Bough did not go to the other: but having wet the
Silk,

Silk, it conducted the Electricity to the other Bough as well as the flaxen Thread.

EXPERIMENT XXIV.

Having mix'd Bees-Wax with about eight times its Quantity of Resin to hinder it from being brittle, and having melted and cast the whole in a round Mould of about ten Inches Diameter and three Inches deep, spreading from the Bottom upwards, a Cake was made, which when cold appear'd to be a Body electric *per se*. This Cake being warm'd, rubb'd, or patted with the Hand, attracts the Thread of Tryal; and sometimes does the same without any thing being done to it, but exposing it to the Air. If you set this Cake on the Ground, and a Man stands upon it, stretching out his Arms horizontally, when the rubb'd Tube is applied to one of his Hands the whole Body of the Man will be impregnated with Electricity; but that Virtue will be most sensible at that Part which is most distant from the Tube, which is the Man's opposite Hand; to which if an Assistant bring his Face near, he will feel the Pricking, see the Flash of Fire, and hear the Snapping;

Snapping ; the Man, render'd electrical, feeling, seeing, and hearing the same. If another Man standing upon another Cake of Resin (or a Cake made of Sulphur, or any other Substance that is electrick *per se*) at a distance, as for example at thirty Foot from the first Man, holds in his Hand the End of a Packthread or any other non-electrical String, of which the first Man holds the other End ; the Electricity communicated to the first Man by the Application of the rubb'd Tube, will be communicated to the second, who makes it be felt by those that come near his Hand that is most distant from the Tube. But if the least flaxen Thread falls from the Packthread, or from the Clothes of either of the Men, so as to touch the Ground, the Electricity will not go beyond that Thread ; but running down in that Place along the Thread, is lost upon the Ground or the Earth. If fifty Men stood upon as many electrical Cakes, communicating one with another by their Hands, or by any Non-electricks, the last will be strongly impregnated with the Electricity that the rubb'd Tube gives to the first.

N. B. This has been tried with a dozen Men ; and it is not known how far this communicated Electricity may be carried.

Electricks *per se*, whilst they are in a State of Electricity, can receive no communicated Electricity (or receive but very little of it at their Ends) from the Tube or other Electricks *per se* excited ; and cannot then become Conductors of Electricity : but it is easy to change them into Non-electricks, and then they will become Conductors of Electricity like others.

The following EXPERIMENTS shew how Electricks per se become Non-electricks.

HAVING suspended horizontally by dry Silks a Glass-Tube six or eight Foot long, also very dry, at the End of which is fasten'd an Ivory-Ball, you cannot give that Ball any Electricity by applying the rubb'd Tube to the other End of the suspended Tube : but as soon as you wet the suspended Tube

Tube from one end to the other with a Sponge, that Tube conducts the Electricity, and the Ivory-Ball attracts.

EXPERIMENT XXVI.

As it has been shewn that communicated Electricity, as it is conducted, jumps from one non-electrick Body to another ; it is not necessary that the Moisture of the suspended Tube should be continuous ; for after the Tube has been well dried, if you suspend it anew, and find that it cannot receive or conduct any more Electricity, you need but to blow thro' it with your Mouth, and the Moisture of your Breath will render it non-electrick, whereby it will again receive and conduct Electricity, the Ivory-Ball acting upon small Bodies as before. Sometimes the changing of Bodies from electrick into non-electrick happens only by the changing of the Condition of the Air, when from being dry it becomes moist.

E X P E R I M E N T XXVII.

Having stretch'd a Packthread Conductor of Electricity to a Length of twenty Foot, upon three electrical Supporters, of which the middle one was a Stick of Sealing-wax, the Electricity receiv'd from the rubb'd Tube applied to one end of the Conductor appear'd at the Ball suspended at the other end; but when instead of the Ball the Stick of Wax that had been us'd as a Supporter was suspended at the end of the String, the Thread of Tryal has not been attracted by this suspended Wax, except at its upper end joining to the Packthread; but upon wetting the Wax, it attracted the Thread of Tryal strongly in all its Length. Then replacing the Ball, and restoring the wet Wax to its Place where it was before a Supporter of the Conductor of Electricity, the communicated Electricity was stopp'd at the Wax, and wou'd go no farther till the Wax was dried.

There are Bodies which one wou'd take for Non-electricks *per se*, because every time they are suspended by electrick Bodies, they
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receive (and become Conductors of) the Electricity communicated by the excited Tube; but if you dry them well at the Fire; and rub them very much, they may be made electrick. These Bodies; and those which from being strongly electrick are become non-electrick by Moisture, will indeed receive Electricity from the rubb'd Tube, and conduct it to their Ends, but in less Quantity, and do not accumulate it so strongly as the Non-electricks *per se*. This is the Reason that we see less Light at the End of a wooden Bar than at the End of an Iron one; and that we hardly feel any pricking at the End of the first, tho' both have receiv'd their Electricity from the same Tube.

It has been thought that Animal Substances were electrick, and Vegetable Substances were not; because those that made the Experiments have generally succeeded in making use of Animal Substances for Supporters, and Vegetable Substances for Conductors of Electricity; but what is true in that Supposition, is only, that because Silks, Fiddle-strings, Strings of Woollen, or Hair, are very dry Substances; and Vegetables are usually

usually moist. For if you wet those Animal Substances, they all become non-electrick, and can no more serve as Supports for the Conductors of Electricity, but will receive it when communicated, and conduct it. Likewise when the Packthread which is usually made use of to conduct Electricity very far, has been rubb'd over with Glue and is very dry, it receives Electricity no longer, till you wet it to make it become non-electrick. A Man, or any other Animal upon a Cake of Resin, or suspended by Strings of Hair or Silk, is always non-electrick ; but is only so because he always has Moisture : for when his Cloaths are dry, they are electrick *per se*, and therefore do not snap. See the 18th Experiment.

When we consider the different Circumstances of several Electrical Experiments, there seems to be a sort of Capriciousness, or something unaccountable in those Phænomena not to be reduc'd to any Rule. For sometimes an Experiment which has been made several times successively, all at once will fail ; or have a quite contrary Success, tho' the Circumstances seem to be the same. But I hope that the Conclusions which I have drawn from

from the Consideration of several principal Experiments, are so general, that they will serve as Rules to explain all the Oddness which seems to accompany the electrical Experiments, and to foretell certainly all that must happen in the Approaches and Combinations of Bodies in respect of Electricity excited, or receiv'd by Communication. Before we give Examples of the Explication of the most remarkable Phænomena, we must make mention of some Experiments, from which among others are deduc'd two other general Propositions to be added to what I have said of Electricks *per se*, and of Non-electricks *per se*; and of the manner that the one and the other acquire or lose Electricity.

EXPERIMENT XXVIII.

Having suspended horizontally by two silken Threads, about four Foot long each, a small Glas-*Tube* very dry and a little rubb'd; if you apply to it long-wise the great rubb'd Tube, it will repel the little Tube till its Silks become inclin'd to the Horizon from being perpendicular before. Then having wet the little Tube, when you bring the
great

great rubb'd Tube near it, it is attracted by the great Tube till its Silks are remov'd from the Perpendicular inclining near to the great Tube. From this Experiment, and many others of the same kind, may be concluded that Bodies which are electrick *per se* being excited to Electricity repel all other Bodies that have Electricity; but attract them as soon as they have lost their Electricity, and so *vice versa*.

EXPERIMENT XXIX.

Having suspended a Down-Feather by a silken Thread, as in the fifth Experiment, Sealing-wax well rubb'd produces the same Effect as the Tube, but more weakly, drawing the Feather; and when once it is separated from the Wax, the Wax repels it continually till the Feather has touch'd some other Body. But what is different here, is, that when the Feather is in a State of Repulsion in respect of the Wax, the rubb'd Tube attracts it; and when the Tube has given the Feather its repulsive State, then the rubb'd Wax attracts it: which shews that the Electricity of Glass is different from the Electricity

city of Wax. The late *Mons. du Faye*, Intendant of the *King of France's* Gardens at *Paris*, was the first that observ'd that there are two sorts of Electricity; and in a *Mémoire* where he spoke of it, he shew'd the Way of finding what kind of Electricity belongs to any electrick Body whatever.

To shew the Usefulness of these Rules, Laws, or Principles of Electricity; we will make use of them to explain the odd Circumstances of some Experiments: as for example,

1^o. Why don't we feel a pricking on the Eyes when the rubb'd Tube is brought near to the Face; since the Ends of the Finger of a Man made electrick, or of an Iron-Bar made electrick, makes the Face that is brought near it feel a very sensible pricking?

Answer. Because the electrical Effluvia coming from the Tube to the Face, are only those which come from that Part of the Tube which is brought near the Face; whereas the Bar gives accumulated Effluvia of the Electricity which it has receiv'd from

all its Length, and from the Tube at several Applications.

2°. What is the Reason that the Feather which, having been attracted by the Tube, is separated from it, and then always repell'd till it has touch'd another Body?

Answer. Because Electricks repel one another. For which Reason the Feather, as soon as it has been impregnated with the Electricity of the Tube, is driven from it; which continues as long as the Feather keeps its Electricity, which it loses as soon as it has touch'd another Body; then being again become non-electrick, the Tube attracts it anew; thus alternately receiving and losing Electricity, it jumps several Times from the Tube to the Finger and back again. See *Experiment IV.*

3°. What is the Reason this does not happen when the Air is moist?

Answer. Because the Feather being become electrical, draws the moist Particles that swim in the Air, and thereby losing its Electricity,

is again attracted by the Tube. The Tube also at the Place which has been the least rubb'd loses its Electricity by the moist Particles which it draws out of the Air, and becoming non-electrick in that Place (as it happens when it is made wet on purpose) draws the Feather before it has lost its Electricity.

4°. Whence comes it that a Conductor of Electricity does sometimes, without changing any thing, lose its Virtue, and cease to conduct Electricity, tho' you continue to rub the Tube at one of its Ends?

Answer. Because some one of the Supports of the Conductor has imbib'd the Moisture of the Air, by which it is become non-electrick. This has happen'd to me in making use of a long Piece of Hat by way of Support, one Day that the Weather was moist. This List of Hat, having been warm'd, supported the Conductor well and effectually; but in half an Hour having imbib'd some Moisture from the Air, it stopp'd the Course of the Electricity. When we make use of Glass-Tubes for our Supporters, this happens sometimes if the Air be very moist.

5°. Whence does it happen that the Feather on the Skewer or Broach of Experiment 2, stretches out its Fibres, separating them from each other by the Attraction of the Tube, and that the Finger repels them when the Tube is brought near to the Feather, but attracts them when the Tube is remov'd ?

Answer. The Fibres of the Feather extend like the Rays of a Sphere, because being become electrick they repel one another. The Finger repels them because it receives Electricity from the Tube; but when the Tube is remov'd, the Finger loses its Electricity, and then it draws the Feather which is still electrical.

6°. Whence does it happen that in the Eighth and Ninth Experiments the rubb'd Tube attracts the Pieces of Leaf-Gold or Brass much farther, when they are laid upon an *insulated* Stand, than when they are laid upon a Table, or when they are shut up on two sides upon the Stand by Books or Boards set edge-wise,

Answer.

Answer. Because the electrical Effluvia flying off from the Tube return again in a Circle towards it, and carry with them all the little non-electrick Bodies which they meet in their way at their Return; but if those non-electrick Bodies are too heavy to be brought towards the Tube, the electrical Effluvia adhering to them, and sliding along those Bodies, lose themselves when the Bodies are not *insulated* or terminated by Electricks: but when they are, the Electricity or electrick Effluvia accumulate at the Ends of those Bodies which are the farthest from the Tube. N. B. *The Tube attracts the Feather when it is cover'd with a Glass Recipient, because the electrical Emanations like Light (of which they seem to participate) easily penetrate electrick Bodies which do not hinder their Circulation.*

For want of having establish'd Rules (that is Principles deduc'd from Experiments) by which one may explain the most odd *Phænomena*, People have imagin'd several Properties to belong to the Electricity of some Bodies, which at last Experience has disprov'd. As for example, That Bodies of different Colours
receiv'd

receiv'd more or less Electricity ; which happen'd only because when the Experiment was first try'd, some happen'd to be more or less moist than others. It has also been thought by some, that small electric Bodies suspended by a fine Thread circulated round a Ball of Iron laid upon a Cake of Resin, after the manner of the Planets round the Sun ; which only happen'd because the Man that made the experiment had a great mind that the Thing should be so, and communicated that Motion to the little Body suspended without knowing that he did it: for this did not happen to any other Person that held the Thread and pendulous Body without the same Inclination. The same may be said of several other Circumstances which are not worth mentioning.

Though I have not endeavour'd to guess at the Cause of Electricity, or its Use in the physical World ; not having *Phænomena* to establish them sufficiently, I hope to have satisfy'd the Gentlemen of the Academy as to what they can expect upon this Subject, in giving Rules or Principles to explain or account for the electrical Experiments that have been
made

made hitherto, and perhaps such as may be made hereafter.

Yet if Conjectures are desir'd, here follow some :

I suppose Particles of pure Air to be electrick Bodies always in a State of Electricity, and that *vitreous* Electricity.

1st, Because Particles of Air repel one another without touching, as has been deduc'd from Experiments and Observations.

2^{dly}, Because when the Air is dry, the Glas Tube rubb'd (or only warm'd) throws out its *Effluvia*, which the Air drives back to the Tube; from whence they dart out anew, and so move backwards and forwards with a vibratory Motion, which continues their Electricity.

3^{dly}, Because the Feather made electrick by the Tube, and darted from it, keeps its Electricity a long time in dry Air; whereas when the Air is moist, the moist Particles which are non-electrick, floating in the Air, and being

being attracted by the Feather, adhere to it, and soon make it lose its Electricity; which also happens even to the Tube in a little time.

From this Consideration it will be easy to account for a famous Experiment of the late Mr. *Hauksbee*, which is this: —

Having pump'd out all the Air from a Glass Globe, he caus'd it to turn on its Axis very swiftly by means of a Rope with a Wheel and Pulley; then rubbing the Glass with his Hand during its Motion, there appear'd a great deal of Light of a purple Colour within the Globe, without any Light or Attraction observ'd on the Outside of the Glass, which is observ'd when the Air has not been pump'd out. Then turning the Cock so as to readmit the Air gently into the Globe during its Motion, the Light was broken and interrupted, diminishing gradually, till at last it appear'd only on the Outside of the Glass, where it was accompanied with Attraction. Does it not appear to be, that at first the external Air, by its Electricity, drives back the electrick Effluvia of the Glass, which go then to the
 Inside

Inside of the Globe, where there is the least Resistance? For we observe that as the Air comes in, it repels the electrick Effluvia, that go inwards no longer when all the Air is come in. If the Fact be so, as the Experiment shews, is not my Conjecture prov'd, *viz.* that *the Air is Electrical?*

In the Reverend and Learned Dr. *Hales's Vegetable Staticks*, several of his Experiments shew, that Air is absorb'd, and loses its Elasticity by the Mixture of sulphureous Vapours, so that four Quarts of Air in a Glass Vessel will, by the Mixture of those Effluvia, be reduc'd to three. Will not this Phenomenon be explain'd by the different Electricity of Sulphur and Air. The Effluvia of Sulphur being electrick repel one another: and the Particles of Air being also electrick, do likewise repel each other. But the Air being electrical of a vitreous Electricity, and Sulphur of a resinous Electricity, the Particles of Air attract those of Sulphur, and the *Molecule* compounded of them becoming non-electrick lose their repulsive Force.

It has for a great while been thought that watery Vapours that rise in the Air to form

G

Clouds,

Clouds, used to rise, because the Water which is of itself specifically heavier than Air (being form'd into little hollow Spherules or Bubbles fill'd with an *Aura*, or thinner Air than the ambient Air) in this new State made a Fluid of little Shells specifically lighter than the ambient Air in which it must rise like Smoke; but Philosophers are no longer of that Opinion; and such as have implicitly come into it, may find it refuted in the *Philosophical Transactions*, Numb. 407.

Now may not this Phenomenon of the Rise of Vapours depend upon Electricity in the following manner?

The Air which floats at top of the Surface of the Water is electrical, and so much the more as the Weather is hotter. Now in the same manner as small Particles of Water jump towards the electric Tube, may not these Particles jump towards the Particles of Air which have much more specifick Gravity than very small Particles of Water, and adhere to them? Then the Air in motion having carried off the Particles of Water, and driving them away as soon as it has made them electri-

electrical, they repel one another, and also the Particles of Air. This is the Reason that a cubic Inch of Vapour is lighter than a cubic Inch of Air; which would not happen if the Particles of Vapour were only carried off in the Interstices of Air, because then a cubic Inch of Air loaded with Vapour would be made specifically heavier than an Inch of dry Air; which is contrary to Experiments, which shew us by the Barometer, that Air which is moist or full of Vapours, is always lighter than dry Air.

The END of the DISSERTATION.





CONCERNING
The several AUTHORS
Who have treated of
ELECTRICITY.

THE Electricity of Amber, precious Stones, and some few other Bodies, was known long ago, and has been mentioned by several Authors, such as *Gassendus*, *Gilbert*, *Digby*, *Sir Thomas Brown*, and many others; but as what has been said by many Authors that have written long ago, has been repeated by others, I shall not mention several that have spoken superficially on the Subject, and written about it when but few electrical Phenomena were known.

The

The first worth mentioning particularly is Mr. *Boyle*, in whose Books you will find an account of several Phænomena of Electricity. See Dr. *Shaw's Abridgment*; Vol. I. from Page 397, to Page 510.

The next was Mr. *Francis Hauksbee* F.R.S. who made a great many new Experiments on the Electricity of *Glass, Amber, Sealing-Wax*, and several other Substances, and their Production of Light upon their Attrition in the Dark; whether *in vacuo*, or in the open Air. See his Book of *Physico-Mechanical Experiments*, printed at *London* in the Year 1709; from Page 17, to Page 69.— From Page 109, to Page 127.— And from Page 131, to 139.

Afterwards Mr. *Stephen Gray* made several new and surprizing electrical Experiments, and pursued his Enquiries and Experiments for several Years till he died in the Year 1736: An Account of which may be found in the *Philosophical Transactions*, N° 366. N° 417. N° 422. N° 431. N° 436. N° 439. N° 441. N° 444.

Monf.

Mons. *De Faye* also made several new and curious Experiments upon this Subject, to be met with in the *History and Memoirs* of the *Royal Academy* of Sciences at *Paris*, for the Years 1733, 1734, and 1735; and in our *Philosophical Transactions* of *London*, in a Letter that he wrote to his Grace the Duke of *Richmond*, N^o 441.

Several Persons in their Philosophical Works have quoted some of these Experiments, but none so fully as that ingenious and accurate Philosopher *Petrus van Muschenbroek*, Professor of *Experimental Philosophy* and *Mathematicks* at *Leyden*; who has written a whole Chapter about it in his *Essays de Physique &c. imprimés a Leyden chez Samuel Luchtmans* 1739. See the 17th Chapter of his first Volume, from Page 254, to Page 272; where he gives a very particular account of most of the electrical Experiments made within these twenty Years, till the Time that he writes; except such as had not been made, or had not been published before that Time.

The rest of the electrical Experiments made since Mr. *Stephen Gray's* Death were made by *Granvil Wheeler Esq*; mentioned in the *Philosophical Transactions* N° 253; and by myself N° 454. and N° 462; besides some others, which I lately shewed the Royal Society: An Account of which is not yet published, but will be in the *Transactions* this Winter. Indeed a few electrical Experiments, made by Mr. *Gray* and my self many Years ago, are mentioned in the First Volume of my *Course of Experimental Philosophy*, from Page 17, to Page 21,



(48)

A
L E T T E R
FROM
PRESIDENT *BARBOT*, &c.
TO
DR. *DESAGULIERS*, &c.

A MONSIEUR,
Monsieur le Docteur *Desaguliers*,
Chaplain de son Altesse Royale le Prince
de Galles, Membre de la Societ  Royale
de *Londres*.

A L O N D R E S.

Bordeaux, 3 Aoust 1742.

MONSIEUR,
J E vous apprends avec bien de la
joye que l'Academie de Bor-
deaux vient de donner le Prix   la
Differ-

Differtation que vous luy avés Envoyée sur l'Electricité, ce qui a pour devise, *Sero sapiunt Phryges.* Cét avantage est d'autant plus flatteur que vous l'avés remporté sur un très grand Nombre de Rivaux.

COMME ce Prix consiste en une Medaille d'Or, je vous prie de charger quelqu'un a Bordeaux de la recevoir en votre Nom & d'en donner une quittance valable. Je suis ravy Monsieur d'être le premier a vous proclamer vainqueur, j'auray l'honneur des vous envoyer des Exemplaires de votre Differtation desqu'elle sera imprimée. Je ne doute pas que le Public ne la lise avec le même gout que nous l'avons Couronnée. Vous l'avés accoutumé depuis longtemps a recevoir tous vos Ouvrages

H

avec

(50)

avec applaudissement. J'ay l'honneur d'être avec une parfaite Estime & un Attachement respectueux,

MONSIEUR,

Votre tres-humble

& tres-obeïssant Serviteur

B A R B O T.

Mon adresse est à Mr. le President BARBOT, Secretaire perpetuel de l'Academie de Bordeaux, sur les fossés du Chapeau Rouge, à Bordeaux.

F I N I S.

BOOKS printed for W. Innys and T. Longman.

1. **A** Treatise of the Five Orders in Architecture. To which is annex'd, a Discourse concerning Pilasters, and of several Abuses introduc'd into Architecture. Written in *French* by *Claude Perrault*, of the Royal Academy of *Paris*, and made *English* by Mr. *John James* of *Greenwich*. The Second Edition.

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3. An Introduction to Natural Philosophy: or, Philosophical Lectures read in the University of *Oxford*, *Anno Dom.* 1700. To which are added, The Demonstrations of Monsieur *Huygens's* Theorems, concerning the Centrifugal Force and Circular Motion. By *John Keil*, M. D. Savilian Professor of Astronomy, F. R. S. Translated from the last Edition of the *Latin*. The Third Edition.

4. The Philosophical Works of the Honourable *Robert Boyle* Esq; Abridged, Methodized, and Disposed under the general Heads of Physics, Statics, Pneumatics, Natural History, Chymistry, and Medicine: The whole illustrated with Notes, containing the Improvements made in the several Parts of Natural and Experimental Knowledge since his Time. In Three Volumes. By *Peter Shaw*, M. D. The Second Edition, corrected.

5. Christophori Cellarii Smalcaldensis Geographia Antiqua, recognita denuo, & ad veterum novorumque Scriptorum fidem, Historicum maxime, identidem castigata, & Quinta Editione plurimis Locis aucta & immutata. Huic demum Sextæ Editioni tot Chartas ex majori auctores Geographia Antiqua quot ad minorem hanc illustrandum requirebantur, duplicemque Indicem, quorum Priori Vetera locorum nomina Novis præponuntur, Posteriori nova Veteribus. Ad-didit, totam recensuit, & Scholârum usui accom-modavit, *Samuel Patrick.*

6. Universal Arithmetick : or a Treatise of Arithmetical Composition and Resolution. To which is added, Dr. *Halley's* Method of finding the Roots of Equations Arithmetically. Written in *Latin* by Sir *Isaac Newton*, and translated by the late Mr. *Ralphson*, and Revised and Corrected by Mr. *Cunn.* The Second Edition very much Corrected.

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Miscellaneous Observations

together with

a Collection of Experiments
on

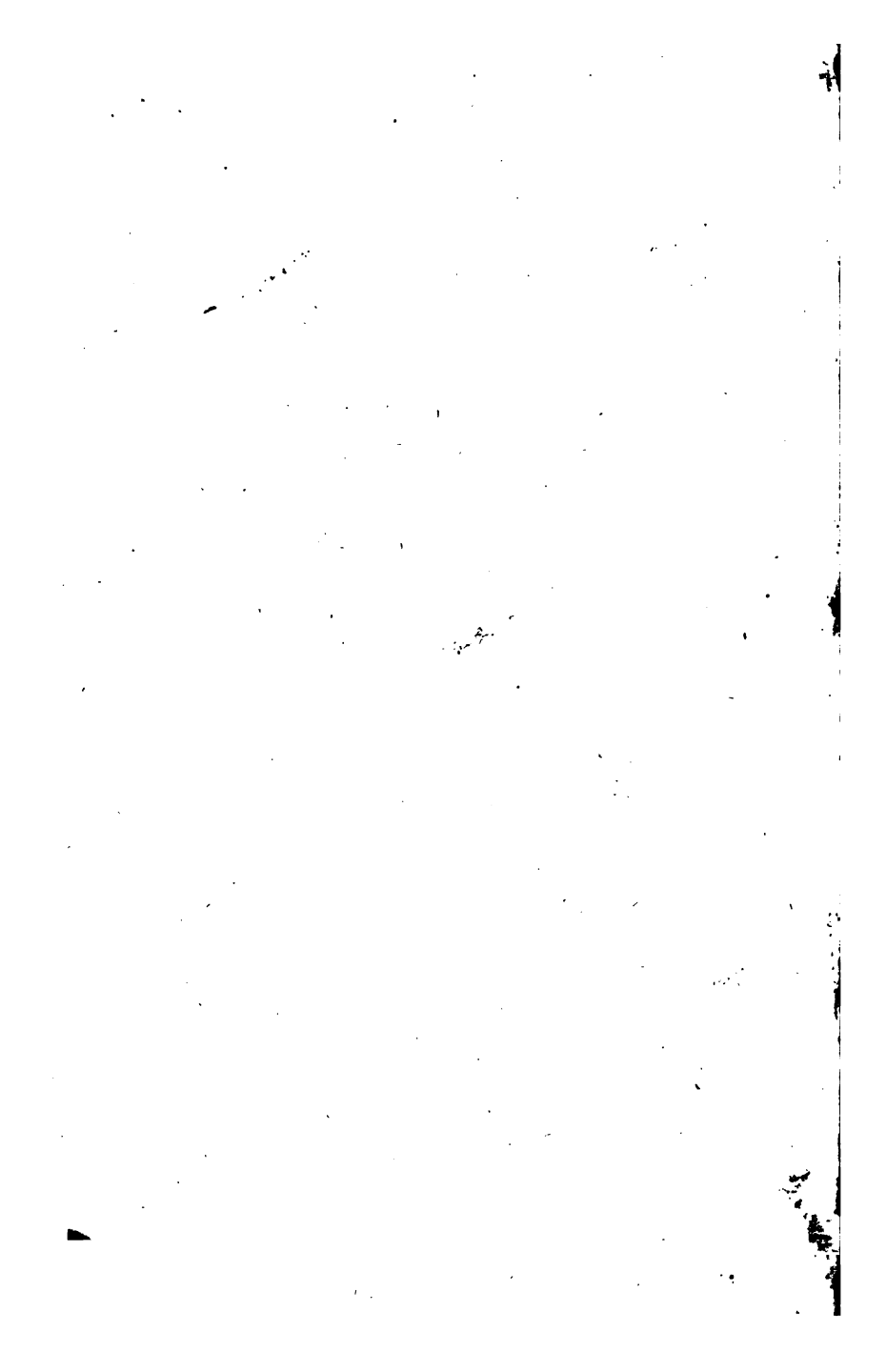
Electricity.

by

D. Rackstrow

Figure Maker & Statuary, at Sir Isaac
Newton's Head in Fleetstreet, London

London



Miscellaneous OBSERVATIONS
ON
ELECTRICITY.

NUMBERS of learned men agree, that whatever *effluvia* the earth affords impregnate the air; and that these are kept asunder by pure *Æther*: but to speak as an operator in Electricity, those *effluvia*, becoming saturated with electrical fire, repel each other. Sir *Isaac Newton* observes, that the particles of vapours, exhalation and air, do stand at a distance from one another, and endeavour to recede as far from one another as the pressure of the incumbent Atmosphere will let them: for he conceives the confused mass, vapours, air, and exhalations, which we call the Atmosphere, to be nothing else but the particles of all sorts of bodies of which the earth consists, separated from one another, and kept at a distance by the said principle.

Philosophers both antient and modern mention the air's being made fluid by fire. Several inge-

nious gentlemen deny air to be a distinct Element, but assert it to be a mass of particles the most opposite in their natures to each other, becoming air only by acquiring Elasticity and Volatility from the attraction of some subtil substance, which I take to be the same as our electrical fire, that being endued with the properties of attraction, repulsion, and expansion: it is the most subtil and elastic of all bodies, and seems to pervade and expand itself throughout the Universe; it is the first moving Agent in matter, and that from whence the air derives its spring; it is equally fitted to nourish and destroy, and is every-where ready at hand to break forth into action, being always restless, and very rapid in its motion, penetrating in its nature, and extensive in its effects; which the many surprising experiments we daily make fully prove, as well as those amazing effects it has upon animal bodies. And if we do but consider the great discoveries and improvements made therein within these three years, we must expect, that, by a due application to these experiments, some things may turn out very beneficial to mankind, both as to mental improvement and corporeal benefit.

The circulation is increased by a person's standing only upon a cake of resin, and so electrified, and the effects are so moderate, that they only serve to cheer and raise the animal spirits; for when it acts the strongest, it will increase the number of pulses three or four in half a minute, and when weak, about two; and even that, as I apprehend, may prove of very great service; but what tends to the greatest good, are the shocks given moderately, and with some judgment; and I am well assured, that it will remove many obstructions, and
be

be of great use in paralytic cases; it helps digestion, quickens the circulation of the blood, provokes urine, and causes a freer respiration and perspiration. All these I have often observed, and doubt not but that many other things beneficial to man may farther be discover'd; such as may help in colic, iliac pains, spasms, convulsions, apoplexies, hysteric, rheumatic, and arthritic disorders, &c.

It is a pity, that some concerned in shewing these experiments, and writing upon them, should endeavour to intimidate people from going through them; one by playing tricks to startle, and another by writing something terrible of death and destruction.

Since it is certain, from the similarity between gunpowder and thunder, &c. that several operations in Chemistry have an analogy to the *phenomena* of Electricity, if therefore I should attempt to explain the one by way of analysis from the other, in the following pages, however imperfectly, I hope the candid will indulge me a hearing.

Acid, saith *Homborg*, is never found alone, but always joined with sulphur, which determines it to this or that species producing different salts. Salts, according to *Sir Isaac Newton*, are dry earth and watry acid united by attraction, the acid rendering them soluble in water. He supposes the watry acid to flow round the terrestrial part as the ocean doth round the earth, being attracted thereby. Whatever attracts, and is attracted most strongly, is an acid in his sense; and our electrical flame has both the smell and taste of an acid.

Salts are vulgarly reckoned the most active of the Chemical principles; but *Homburg* derives all their activity from the sulphur joined with them.

Whatever is ascribed to acid may be ascribed to fire, or *æther*. The particles of *æther* fly asunder with the greatest force; and, agreeable to Sir *Isaac Newton's* doctrine, when united, they must attract each other with the greatest force; therefore they constitute the acid; for whatsoever strongly attracts, and is attracted, may be called an acid, as Sir *Isaac Newton* informs us in his tract *de acido*. Hence it should seem that the sulphur of *Homburg* and the acid of Sir *Isaac Newton* are at bottom one and the same thing; viz. pure æther or electrical fire.

Fire inclosed will attract fire. If we consider both natural and artificial glass, it is evident in the natural, such as the diamond, chrystal, *Scotch*, and *Brazil* pebble; all which have their attractive and repelling power upon friction. Glass artificial is a composition of lead and salt of the fixed kind, as salt-petre, such as will not evaporate with the most intense heat, sand or stone that will melt easily, which gives firmness, and consistence to the glass. The stone made use of should be white and transparent, and strike fire with steel. Hence it plainly appears there is fire in the composition; and I can't help thinking but that it must imbibe a great deal in passing through that violent heat, as is evident in making red lead; in calcining antimony and salt of tartar, where a greater weight comes out than was put into the fire; wherefore the red lead, &c. should seem impregnated with fire.

In spirits of nitre you will find the ignited bodies always in motion ; witness the fume when the stopple is pulled out : As for the flint made use of, it carries fire in it.

From lead are made various compositions, which contain both salt and sulphur. Hence may be gather'd that the principal composition of glass is fire.

It is certain that the *apparatus* is concerned in a more particular manner than the grinding of the air between the glass and hands, or cushion ; for if you lay a glass tube in the sun, it will acquire the power of attracting and repelling. There can be no grinding of the air in this experiment ; it is only the motion which the sun puts the glass into that makes it attract the lambent flame ; and those subtil particles which are in the glass, being put into motion by the very swift revolutions of the glass globe and attrition of the hands at the same time, we may as well suppose the air to be whirl'd round the sphere as water round the grind-stone ; and if we will allow, that fire inclosed, put into motion, will attract fire, it is but reasonable to think, that when the fiery particles which are in glass are excited by attrition, they will attract and set at liberty the æthereal fire from those gross and heterogeneous particles that clogg'd and restrain'd it from its natural activity ; but once let loose, it swiftly flies through all metals, vegetables, and animals that come into contact, and are suspended by silk lines, or stand upon such bodies as have a power of attracting and repelling, such as glass, amber, wax, resin, &c. when excited by friction, before it mixes with the universal æther ; and as it

passeth through the before-mentioned bodies, it has the power of attracting and repelling all light bodies, and of attracting fire out of the animal body ; and it is reasonable to think, that those bodies that are become electrified have the power of attracting the particles of *Æther*, as well as the excited globe ; and we observe accordingly, that the lambent flame flies through all these bodies almost instantaneously ; viz. the wires, gun-barrel, &c. and the particles of *æther*, having the power of attracting, bring along with them in their progression all light bodies ; but when those light bodies touch the body electrified, they become saturated and repell'd with force, by the fresh influx of *Æther*.

It is allowed, that bodies electrified form to themselves an Atmosphere, which corroborates what I have said ; for, suppose a copper globe electrified, it will attract in all directions the particles of *Æther* that are within a certain distance ; all these particles have a tendency towards the centre of the copper globe, and in their progression bring along with them all such light bodies as they meet within their sphere of action, such as thistle-down, &c. ; but these light bodies no sooner touch the electrified copper globe than they become fill'd with *Æther*, and form an Atmosphere to themselves, whose centre of motion being different from that of the globe, and being the lighter bodies (and by force of the fresh quantity of electrical fire darting into the thistle-down, continually rushing from the excited glass globe), they are repell'd, and kept out of the sphere of action of the copper globe, or other bodies electrified, their pulses being in different directions ; but if we were not to send a fresh quantity of *Æther* they would not be repell'd, for the action would cease.

It is observ'd, that urine produceth no phosphorus till it be long exposed to the air ; from all which we may conclude, that bodies attract and fix the light.

That light or fire which is attracted and fixed by the urine being exposed to the air, must be what we call electrical fire, or pure *Æther* ; for both phosphorus and Electricity have the peculiar property of appearing much more luminous *in vacuo* than where the culinary fire can subsist.

Both new and old bays attract this fire ; and it has often been observed in a frosty night, that the bays shall look luminous, and at the approach of a finger to it that the electrical stroke shall be felt.

Fire or light mixeth with all bodies, even with water ; witness the flashing lights in the sea, whose waves seem frequently all on fire, as do those luminous exhalations from putrified waters called *ignes fatui*.

The experiment of the phial of water is an immediate and substantial proof of this ; and farther evinceth what the bishop of *Cloyne* saith, that *Æther*, fire, or spirit, being attracted and clogg'd by heterogeneous particles, become less active ; and I have kept a phial of water almost ten hours, which I had electrified before it had lost its electricity.

And again, the heterogeneous particles cohering with those of *æther* become more active ; witness the water from the capillary syphon, which, from mere dropping, is forced to run a full stream when electrified.

This

This also proves the repelling force, by the fresh quantity of Æther rushing on; for it is to be observed that the Electricity swiftly passes away from the end of a small wire, in diverging rays representing a lambent flame, and so from the end of the small syphon the electrical flame works off, and swiftly moves the water along with it.

In Dr. *Desaguliers*'s course of experimental philosophy, he asserts air to have the following properties, on which I have made the ensuing remarks; viz.

- ‘ That air is a fluid, consisting of parts that
- ‘ drive each other from their respective centres;
- ‘ because it has been found by experiments, that
- ‘ its density is equal to its compression; and Sir
- ‘ *Isaac Newton* has demonstrated such a fluid must
- ‘ consist of parts that have a centrifugal force.’

I imagine the air or atmosphere to be the *effluvia* of the earth saturated with electrical fire, which causes those *effluvia* to repel each other, and expand every way, and to be of such an elastic force as to cause their density to be equal to their compression.

- ‘ That air near the earth is in a compress’d
- ‘ state, by reason of the great weight of the air
- ‘ above it: the atmosphere is no higher sensibly
- ‘ than about 45 miles, as is shewn by considering
- ‘ how high the mercury must stand in the baro-
- ‘ meter at different heights above the surface of
- ‘ the earth.’

By this it appears to me, that the farthest that the *effluvia* of the earth are attracted from the surface thereof is not above 45 miles; and these *effluvia*, being acted upon by the electrical fire, are repell'd and kept at a distance every way from each other; and that it is these *effluvia* that press against all terrestrial bodies, which is what we call the pressure of the air or Atmosphere. For the electrical fire, or pure Æther, could not have that effect alone; the particles, being so very subtil, would pass through the pores of most bodies: and the reason that we have no pressure from that which is above 45 miles from the surface of the earth, is, that it is pure Æther, of so subtil a nature, as to pass through the pores of bodies, and not to press upon those bodies.

‘ The air always endeavours to continue of the same tenour: if it be condensed or rarefied in one place, when left to itself, it will return to its former density. Upon this principle are artificial fountains fill'd and play'd.’

Let us suppose air to be condensed in the barrel of a wind-gun; if then the *effluvia* of the earth, cohering with Æther, be what we call the air, and if to Æther air owes its spring, and if such Æther be of so very subtil a nature, why does it not pass through the pores of the barrel; and by that means the air that was condensed in the barrel lose its spring? I answer;

There being no more Æther than enough to saturate the *effluvia*, I believe it would not fly off from the *effluvia*; but if it were possible to fix it at liberty

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in

in the *vacuum*, it would expand itself and *effluvia* to a surprising circumference.

In the experiment of a tight-blown bladder being put upon an air-pump under a receiver, and the air exhausted so as to take off the pressure of the air from the bladder, the *Æther* does not pass through the pores of the bladder, and leave the *effluvia* behind, but causes the *effluvia* to expand, and burst the bladder with a loud report. The same may be done with a square glass bottle. But when *Æther* is separated from all such heterogeneous particles as can restrain it, as we separate it when we shew the electrical experiments, the *Æther* passes through the pores of the bladder, as it does through the pores of all metals.

But the pressure of the Atmosphere (being of the same quality with that which is condensed in the gun-barrel or bladder) keeps up the equilibrium, as the air in the body enables us to bear the pressure of the Atmosphere, and has the power to repel or prevent the electrical fire or *Æther* passing through the pores of the barrel or bladder, and by that means preserves the spring to the air within of them.

Air is therefore a mass of various particles, abraded and sublimated from wet and dry bodies of all sorts, cohering with the particles of *Æther*. But *Æther* being separated from those heterogeneous particles becomes exceedingly more active. I have, by endeavouring to separate them, become so strongly electrified, that I have emitted fire that has been both sensibly felt and seen, without my standing upon any electrical bodies, but only upon the bare boards, and even without shoes.

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The method I made use of to separate the electrical fire from the particles that clogg'd it will be described in the experiment of the Chair. But as to pure Æther, or electrical fire, the excited globe attracts the greater part, if not all, from the air. I need not except what is attracted from the non-electric by the *Apparatus* when electrified; the non-electric recovering its fresh supply from the air: for when we have an intense watry Atmosphere, and the pressure of air the least, we can get but very little Electricity; but in a fine clear day, when the pressure of the air is greatest, we get the greatest quantity of electrical fire.

Query. If this fire was attracted from the floor, as Mr. *Watson* supposes, why should we get the most Electricity when the pressure of the air is greatest, as it is in the finest days? One might naturally think that the great pressure would tend to keep it within the earth; and if it is attracted from the floor only, what need we mind the state of the air, or whether our supporters are non-electric or not?

It may be observed in the experiment of the Feather, that when the globe begins to turn to electrify, the plumes of the feather are first attracted downwards; which shews that the stand the Feather is placed upon, as it becomes electrified, has the power of attracting the particles of Æther that are in the air; which particles bring down the fibres of the Feather, as they are attracted towards the stand; so the Feather seems to sink before it is electrified, as it does when a non-electric touches any part of the wire that is in contact with the Feather when electrified; but when the stand becomes saturated.

and forms an Atmosphere of electrical *effluvia* itself, those *effluvia*, by getting between all the small fibres of the Feather, cause them to expand, and their points to be kept at a distance as far as possible, as they do in all bodies that float in air. ‡

Before I shew'd the electrical experiments in public, I set my machine, and the man that turn'd the wheel, upon resin, to collect much more of the Electricity, but found myself deceived : I therefore concluded immediately, that as one magnet would not attract another, but a piece of steel being within a proper distance of a loadstone, the attraction would be immediately perceivable, so two Electrified Bodies do not attract each other, but endeavour to recede from one another as far as they can. Therefore I was not surpris'd when I made these and some other reflections, that the machine, when set upon resin, and the men that work'd it, should lose the power of collecting the Electricity : for we may consider them as in air, so the gun-barrel, wires, &c. the same ; the resin or silk not allowing the electrical fire to pass thro' them into the floor : but seeing that the man who holds his hands, and he that turns the wheel, and all the wood, and metallic part of the *Apparatus*, while on the floor, are non-electric ; therefore they are ready to attract and convey the Electricity.

This pure Æther, Fire, or Light, the mighty Agent in the hands of our Great Creator, expands itself through the heavens, is always restless, and instantaneous in its motion ; is absorbed by the earth in one part, and flies out at another ; passes through and pervades the pores of all bodies ; and when the glass globe is strongly excited by the attrition of the hands, and the air gather'd round the

the

the glass sphere, the æthereal fire therein is attracted, loosen'd, and separated thereby from the watry and earthy particles that clogg'd it, and passes off in a current from each hemisphere of the excited globe, through the man that holds his hands upon the globe, from one hemisphere; and through the gun-barrel, wires, &c. from the other; which being properly suspended by silk lines, clog and restrain the Electricity from its natural activity; which we are sensible of upon the approach of a finger: we may see the fire, and feel the stroke; but tho' it passes through the man that holds his hands upon the globe to excite it, as he stands upon the ground, he is neither sensible of it, nor those who attempt to touch him: but if he stands upon resin, he becomes strongly electrified; tho' if a non-electric takes hold of the man that stands upon the resin, and is electrified, he immediately loses his Electricity, it is attracted by the non-electric from him; which instantaneously passes through, and is absorbed by the earth.

While this is transacting on one side of the globe, let a non-electric take hold of the gun-barrel, or the wires that convey the Electricity, on the other side, and all on that side will lose the Electricity that instant, it passing through them that take hold into the floor. Now the Electricity being taken off on both sides, let a third person hold the wire of the phial of water against the globe, and it will electrify it. (All the while the globe must be kept in motion, and the man hold his hands upon it.)

I can no-ways conceive how the very thing that takes away the Electricity; should convey it to the globe to electrify water: I should rather think,
since

since the men and the *Apparatus*, viz. the wood and metallic part, are non-electric while standing upon the ground, that they would assist in attracting and letting loose the electrical fire from the air; one part of which immediately rushes through the man that holds his hands upon the globe into the floor; whilst the other part passes through the gun-barrel, wires, &c. but not so instantaneously; for which reason it assists us in shewing the experiments.

The gun-barrel, wires, &c. when electrified, have the power of attracting the æthereal particles that are in the air; those particles attracted are in most of them in different directions to those which came from the glass globe, and electrified the gun-barrel, &c. the continual efflux of electrical Æther from the excited glass globe, acting stronger than those particles that are in air, as it rushes through the electrified bodies, is that which makes it necessary for a non-electric to be held nigh the gold or silver Leaf, in its suspension, to take off the Electricity as fast as the upper plate electrifies it; it is this that keeps the æquilibrium; and the repulsion the Electricity meets with in the gun-barrel from those particles in the air, confines it longer to those bodies we call Electrified, than to those through which the current of Æther passes into the floor; the particles being in one direction makes the motion instantaneous. We first by motion set at liberty this electrical fire from the particles that clogg'd it, and afterwards strive to restrain it from its activity, that we may make use of it to shew these surprising experiments.

Mr. *Watson* (in p. 59. of his *Sequel to the Experiments*) in giving a solution of the suspension of the silver leaf, says,

1. That the blast of electrical Æther from the excited plate blows the silver towards the plate unexcited: this last, in its turn, by the blast of electrical Æther from the floor setting through it, drives the silver towards the plate electrified.

As to the blast of electrical Æther, it would repel the silver, if it was not for the non-electric attracting the Electricity from the silver as fast as the excited plate electrifies it: I say it is as a canal of communication, which discharges the Electricity from the excited non-electric to the unexcited one. Let any one try this experiment, by holding the back of his hand under the silver, instead of the plate, and he will feel the Electricity blowing like a cold air against his hand (the feeling giving us no positive notice of any degree of fire below the natural heat of the body, or of any so great as to destroy the organs).

It appears by this, that the Electricity is passing through the non-electric into the floor; and not that it comes from the floor, and so blows the silver towards the electrified plates.

When thistle or feather-down, &c. are attracted by a body electrified and repell'd, they never will touch an electrified body, till they have touch'd a non-electric, to which they communicate their Electricity, and so are made ready to be fresh attracted; but are not blown back again by the non-electric: for if a non-electric touches thistle-down, &c. after they have been repell'd, even at three feet distance from the electrified body, they will be attracted back again, though the person, as soon as he touches it, gets as far from it as he

he can; I rather take it that the plate electrified has the power of attracting the particles of Æther that are in the air, and that these particles, having the quality of attraction also, bring along with them thistle-down, or any light body; and that the Electricity which passes through the silver, and is felt on the back of the hand of the non-electric, is the Æther that would repel the silver, and not that which did attract it.

‘ 2. That we find from hence likewise, that the draught of electrical Æther from the floor is always in proportion to the quantity thrown by the globes over the gun-barrel.’

When we can collect the most Electricity by the excited globe, the most is attracted from the air by the body electrified as well as from the non-electric, and its action is greatest on a clear dry day, at which time the animal body seems to be possessed of more electrical fire, or at least is more active, and more chearful and enlivened; but contrariwise, on a dull day the spirits are heavy and oppress’d.

By the quantity thrown *over* the gun-barrel, I confess I no more understand him than I should if he had said thrown *under* the gun-barrel. I am pretty well assur’d, that he does not mean, that the Electricity is as a *capsula* to the gun-barrel; and if he did, he would be much in the wrong; for I can prove by experiments, that it passes through the pores of all bodies it electrifies.

‘ 3. He farther observes, that a Gentleman whose shoes were perfectly dry, and of consequence originally-electric, and who was employed
‘ to

‘ to hold the non-electric plate, through which
 ‘ the Æther was to come from the floor. This
 ‘ gentleman, he said, did not furnish a sufficient
 ‘ quantity (because of the driness of his shoes) to
 ‘ maintain the æquilibrium, and so the Silver was
 ‘ blown away.’

This gentleman, he supposes, acted the same as if he had stood upon a cake of Resin, the soles of his shoes being thick and dry; and some animal substances, when dry, will not let the Electricity pass through; whereas the truth of the matter seems plainly to be this; viz. that the person who holds the under plate standing upon the resin becomes electrified by the Electricity passing through the Leaf to him; and being fill’d, cannot take any more from the Leaf, and the silver becomes saturated and repell’d by the under plate as well as the upper one; so that when the Æther comes from him that holds the plate, the Leaf is blown away, instead of being kept in the state of suspension. But if the person employ’d to hold the under plate endeavours to catch the Leaf in the plate, he may; and then, if he holds the under plate about the same distance from the upper plate, as he did when the Leaf was suspended, and stand some little time in that posture, the Electricity, which the silver and person receiv’d, that held the under plate, from the excited upper one, beginning to pass off thro’ the emunctory pores into the Air, (for it can’t pass through the resin into the Floor) the Leaf will be fresh attracted, and again saturated and repell’d, and will act in this manner as long as you have a mind to try the experiment: therefore the Electricity that forces the Silver to the excited plate must come from the Air; it cannot come from the Floor, as not being able to pass through the Resin.

P. 60. Mr. *Watson* further says ; ‘ But I am able to prove the Afflux experimentally, as well as the Efflux, in the following manner : When the Silver lies still, though the motion of the globe is continued between the two plates, one suspended upon the gun-barrel, and the other placed upon an electrical cake, a person standing upon the floor, needs only bring a small glass Syphon in a vessel of water, and apply the long leg thereof near the plate placed upon the wax ; for upon this the Silver is immediately suspended, and the water, which before only dropped, now runs in a full stream, and appears luminous. Does not, in this case, the current of the Water point out the direction of the current of electrical *Æther*?’

I say it does ; and shews, that it takes the Electricity from the plate, that was before electrified, and conveys it into the floor ; and not that it passes from the floor into the person that holds the water, and then through that into the plate, and so blows up the Leaf.

To corroborate this, try the following experiment. Let the upper suspended plate, which is about ten inches diameter, be electrified, and the under plate, about 18 inches diameter, be set upon a cake of Resin, at a proper distance from the upper one ; and let a person, standing upon the ground, place one finger upon the under plate, and the Silver will be suspended ; then try, by bringing a finger of your other hand very nigh the under plate, to see if it is electrified, and you will find it is not ; and this is the time at which he supposes the Electricity is blowing from the under plate to suspend the Leaf : but what electrical
fire

fire it receives from the upper plate through the Silver will be instantaneously convey'd into the floor, the particles being in the same direction : now let the person take the finger off the under plate, and the Silver will be but a little while suspended, but begins to be attracted and repell'd ; it is collecting the Electricity from the upper plate, and conveying it to the under one, and seems to grow weaker and weaker, and at last lies at rest upon the under plate ; both the Silver and plate becoming saturated with Electricity, if you try with your finger you will find the plate is electrified ; you may see the fire, and feel the stroke. Whilst the Leaf continues electrified, it has the power of repelling the particles of Æther that are attracted from the air, and which would disturb it if not electrified ; but, upon the approach of the long leg of the Syphon, the water just at first is attracted in a full stream, tho' immediately after only it drops, and the Silver is only attracted and repell'd faintly ; but, on the nigh approach of the Syphon, it will be suspended.

This is no more than as if a non-electrified person was to put his finger on the under plate, which would take off the Electricity. I agree, that bodies electrified will attract the Electricity from the non-electrified person, so as to meet in different directions ; but when the Electrified body attracts the Electricity from the Non-electric, there is no medium between, no silver Leaf, Feather, or Thistle-down, &c. The greater body will attract to itself the lesser : there can be but little Electricity in the Silver ; therefore it is attracted by the Non-electric ; there is but little in the Feather, or Thistle-down, or such light bodies ; therefore they are attracted by the Non-electric, and convey'd into the Floor.

A person highly electrified, standing upon Resin, no sooner lets one foot touch the floor, but all the Electricity is absorbed by it. And this is agreeable to what I have asserted, *viz.* that the electrical Æther is expanded throughout the whole mundane system.

P. 63, 64. he further adds: ' When the machine, &c. are placed upon Originally-Electrics, if a man, standing likewise upon Originally-Electrics touches the gun-barrel while the globes are in motion, he will receive a snap or two; after which, though the motion of the globes is continued, he will receive no more fire from the gun-barrel. While in this posture, if he touches the wood-work of the machine with one hand, and applies a finger of his other near the gun-barrel; at that instant he receives the electrical strokes: these continue as long as he touches the machine, but cease upon his removing his hand therefrom. Here we see a circulation of part of this man's electrical fire, which operates in the following manner: First, the man, by applying one of his hands to the machine, becomes a part thereof; and by the motion of the globes, part of the electrical fire inherent in his body is driven upon the gun-barrel; but it is instantaneously restored to him again, upon his touching the gun-barrel with his other hand: thus he continues communicating the fire with one hand, and having it restored to him with the other as long as he pleases.'

The man, upon receiving the strokes from the gun-barrel, becomes saturated with Electricity; there can be no attraction between him and the gun-barrel, they both being electrified by the same power;

power: upon the man's touching the wood-work of the machine, he gets rid of his Electricity; therefore is ready to receive a fresh quantity from the gun-barrel, which he again bestows upon the wood-work of the machine, and so on; and if he was to wait a small space without touching the machine, the Electricity he had received would fly off into the Air, and he, upon approaching his finger to the gun-barrel, would receive a fresh supply.

There is no circulation of part of this man's fire in this experiment: a man saturated with Electricity can take no more, till he has got rid of that, or part of that, which he had received.

Two persons electrified by the same power have no more effect upon each other, than two that are not electrified. They are as two horses or men, &c. that pull from, or push equally against, each other; neither overcoming, they produce no motion: but if two persons, standing upon two cakes of Resin, be placed so nigh, as that, when their arms are stretched out, they might touch, and each be electrified by a different globe, one of these globes would act stronger than the other; and, consequently, one of the persons would be stronger electrified than the other, and, upon approach of their fingers to each other, the electrical stroke will be both felt and seen; till he that is the least electrified receives as much Electricity from the other as to keep up the equilibrium between them; which will be in two or three explosions, and then they can't have any effect upon each other.

Some other experiments, back'd by this, have made some (who think too lightly of the matter) not

not only to imagine, but assert, that all the electrical fire comes from the body Electrified, and none from the Non-electric : that the electrical particles do not meet in different directions, but rush on in a current one way, that is, from the body Electrified to the Non-electric ; which is as much as to say, there is no attraction, and that there is only the repulsive force ; or if they allow of attraction, it must be the Non-electric that attracts the Electricity from the body Electrified ; and not, that the body Electrified has the power of attraction ; and then where is the repulsive force ? By this way of reasoning they destroy either the attractive or repulsive power.

It is a known principle in attraction, that the greater body will attract the less to itself ; that a person Electrified, and a Non-electrified one, have (for certain) the power of attracting the Electricity from each towards each other ; but the body electrified must have the power of attracting the strongest ; and where the attractive power ceases, the repulsive begins ; which must act stronger from the body Electrified than from the Non-electric : therefore some of its Electricity at that time darts into the Non-electric, as endeavouring to keep up the equilibrium ; a known principle of the Air, for which it is indebted to Æther : for Air, left to itself, will be always the same ; which enables bodies to bear the pressure of the Atmosphere.

By desire, I have here made some remarks upon such bodies as I found Electric, and such as I found Non-electric ; though, in a strict sense, there is no such thing as a Non-electric, all bodies being endued with more or less of Elelectrical fire.

Of ELECTRICAL BODIES.

1. **T**HOSE bodies that repel the electrical fire, and will not suffer the Electricity to pass through them, and, when excited by friction, have the qualities of Attraction and Repulsion, such as Amber, Glass, Wax, Resin, Pitch, &c. may, for distinction-sake, be call'd Electrics *per se*.

2. Bees, Beetles, Moths, and Flies, both *Indian* and *English*, the Chrysalis's of Caterpillers that spin like the silk-worm, are electric when dry; and Land-Shells, Silk, Leather, Hair, Woolen, Tortoise-shell, Fat or Tallow, *Sperma Ceti*, and such sort of animal substances, though they have not the virtue of attracting and repelling, are term'd Electrical, because they will not suffer the Electricity to pass through them.

3. Brimstone, Cinnabar, Tutty, a faint Electric: Camphire and other Gums are Electric.

And I have observed, that the Fat of Animals, and the resinous Juices of Vegetables, are Electrical bodies, and both serve equally to the preservation of the individual from whence they proceed.

Of NON-ELECTRICS.

WHAT we call Non-electrics, are such bodies as serve for Conductors of Electricity; *viz.* all that will suffer the Electrical fire to pass through their pores. It was generally thought, that all animal substances, when dry, would not convey Electricity, wherefore they were term'd Electrics; but among the following are some animal substances, which, when dry, I have tried, and found conveyers; therefore they are Non-electric.

1. The Jaw of a Shark, Sea Unicorn's Horn, Sword of the Sword-fish, Joints of the Back-bone of a Whale, Horn of a Rhinoceros, Stag's Horn, Elephant's Tooth, human Skeleton, Bones in general.

2. Bones, Arteries, Veins, Muscles of a Boy preserved.

3. Skin, Bones, Muscles belonging to it, and Hoof of an Elk; but no great conveyer.

4. The Sea-Turtle, Pizzle of a Whale, and Sea-Shell in general, Crocodile, Flying Fish, and Old-Wife.

5. Skin of the scaly Lizard; but not a great conveyer.

6. Oils of Hartshorn and Vitriol.

7. All sorts of Waters.

8. Most kinds of Earth, and Stones, even the Loadstone.

9. All Animals alive or dead, if the fluids are in the body, are Non-electrics, being great conveyers of Electricity.

10. All Vegetables, while growing, are Non-electrics; most part when not growing.

11. Minerals, such as Alum, Vitriol, Salt-petre, and Antimony.

12. Metals in general.

1. We find, among the list of Electrics and Non-electrics, that the Chrysalis's of those Caterpillars that creep into the Earth, to change into the Aurelian State, when dry, are Non-electrics.

2. But the Chrysalis of that Caterpillar which spins like a silk-worm, is Electrical.

3. Sea Shells in general are Non-electric.

4. Land-Shell Electrical.

5. Oils made from the parts of Animals, or Vegetables, that are in themselves Electrics, will be

be Electrical; such as Train, Turpentine, and Linseed Oils.

6. But Oils made from Metals and Minerals, as Oil of Vitriol, or from parts of Animals that are Non-electrics, as Hartshorn-Oil, are Non-electrics.

This Æthereal or Electrical Fire I take to be the vivifying spirit that resides in Air, which, taken into the lungs of an animal, is separated from the heterogeneous particles, and those watry and earthy particles are again immediately repell'd out of the lungs; but the pure fire swiftly passes over the whole body, which, mixing with the blood, keeps it in due fluidity, and free from coagulation; for most fluids are both Retainers, for some time, and great Conveyers of Electricity; the Æther seeming to agree more with fluids than any thing else, and to stay longer with them. This keeps the fibres in due vibration, and the fluids in proper motion, actuating the whole mass; but changes, as heat and dryness, cold and moisture, &c. alter the Elasticity of the Air, keeping open and cleansing the most minute pores and passages of the body.

Without this fire in the Air, the culinary fire could not be kindled, nor life preserved. It has been found by experiment, that what is not good for one will not serve for the other; that Air, taken out of the lungs will neither feed life nor flame. As it is the great medium of Respiration, so it is of Digestion, Sanguification, Nutrition, Pulses of the Heart, and Muscular Motion; and I believe it to be what some call the Animal Spirits; as for other qualities of the Air, iron and copper are corroded, and gather rust in the Air, and all sorts of bodies are corrupted and dissolv'd.

By this is shewn an acid diffused throughout the Air ; and, as the Bishop of *Cloyne* observes, Air is as a general Agent, exerting its own, and calling forth the qualities or powers of all other bodies, by a division, comminution, and agitation of their particles, causing them to fly off, and become volatile. In animals living or dead, their fluids are as a vehicle to *Æther*. The animal, while alive, has Heat, and Heat ; according to the Peripatetics, will attract homogeneous things, and disperse heterogeneous, which keeps the body from corruption ; but when dead, and that Heat has left the body, the heterogeneous particles have power to act upon it ; there being no drug, salutary or poisonous, whose virtues are not breath'd into Air. Here we find the *Æther* cohering with heterogeneous particles on one hand, dividing, abrading, and attracting the volatile particles of all bodies, that are in the state of corruption, into Air, and there preserving those particles, as in a safe Repository, till a proper season to bestow them again in new generations. Acid volatile Salts, Earth, and Water, are nutriment to Vegetables, these to Animals ; and the volatile Salts of Animals, while in a state of putrefaction, fly off into Air again, mix with the Earth and Water ; which keeps up the round of putrefaction and generation.

Having given this account of the nature and properties of Air and *Æther* (wherein the expressions Electricity, Electrical Fire, and *Æthereal* Fire, are synonymous) and also of what substances I have found to be Electrics, and what Non-electrics, it now remains that I should verify the doctrine by experiments, and make some remarks

thereon ; which is humbly offered in the manner following :

1. The late ingenious Mr. *Hauksby* was the first that made use of the glass globe, in what he called his Attrition-Engine ; he exhausted all the Air out of it, and when it was whirl'd round, and the particles of glass put into motion, by the attrition of the hands, the Electricity acted wholly within the globe, and appear'd as a flame of a purple or reddish colour, filling the whole globe, which disappeared by degrees, as the Air was gradually admitted into the globe.
2. Circular strings of threads being fix'd on the Axis in the centre of the globe, and a small distance from each other, the globe being put into motion, and giving a proper friction to it, all the threads extend themselves from the centre to the inner surface of the globe, and nearly represent the spokes of a Coach-wheel, being expanded by the Electricity acting through the pores of the glass.
3. If the hand of a Non-electric be moved towards the surface of the globe, the threads within move every way towards the hand : which shews that the Electricity attracts through the pores of the glass ; and as the electrical particles move towards the hand, they bring along with them the points of the threads.
4. Place a hoop of threads about the globe in motion, and the threads fasten'd to the hoop will be attracted towards the surface of the globe.
5. The Room being darken'd, the ends of the threads on the outside of the globe will appear luminous ; but the threads within exhibit no light.

In these last experiments the globe is not exhausted, as it is in the first: which demonstrates, that when the globe is not exhausted, the Electricity acts outwardly; but when exhausted, inwardly.

A SYLLABUS of the EXPERIMENTS

Which I Exhibit.

EXPERIMENT I.

A FEATHER being suspended by a hempen or flaxen thread, and held near an electrified body, will be strongly attracted thereby, and adhere immovably thereto; the Electricity being convey'd away through the thread, as fast as it receives from the electrified body.

EXP. II.

If a Feather be suspended by a silken string, it will be first attracted, and then repell'd; and continue so till it has touch'd a Non-electric; then it returns again to be electrified, and so on. The Silk will not convey the Electricity away; so the Feather acts as light bodies, that float in air.

EXP.

EXP. III.

All such light bodies as will float in the Air, as thistle or feather-down, &c. or raspings of cork, leaf-gold, several sorts of seed, &c. if nigh an Electrified body, will be attracted, and then repell'd ; but if touch'd by a Non-electrified body, before it be out of the sphere of action, it will return to the body electrified, and will be again repell'd. For when these light bodies, being electrified, touch a Non-electric, they lose their Electricity : they are put into the state they were in before electrified, and consequently ready to be fresh attracted.

EXP. IV.

To shew attraction and repulsion at the same time, you must have a little plate of metal, about two inches in diameter, made smooth, and fixed to the gun-barrel so as to be electrified ; put some Raspings of Cork, &c. thereon ; also take some of the same on the blade of a knife, and hold it under the plate, at two or three inches distance ; then laying one of your fingers on the gun-barrel, cause it to be electrified ; and when you take your finger off, that which lies upon the plate will be repell'd upwards, and that on the knife attracted upwards at the same instant.

Note, What is attracted upwards, as soon as it touches, is repell'd ; and that which lay upon the plate, upon your taking off your finger that instant is electrified and repell'd.

EXP. V.

Suspend a gun-barrel, or any metallic body, by silk lines, and apply the finger to within about half an inch of it when electrified, and you will receive

receive a smart stroke, see the fire, and hear the snap by the Electrical explosion. The electrified body and the Non-electric act equally alike. You may observe the fire to be attracted from the end of your finger, if the top be wet, and approaching the electrified body; or from the end of a key, &c. if held in your hand. This fire is attracted with vigour from the Non-electric; and since you may hear a singing noise as it passes through the pores, it is plain it is attracted with force; and if you move the key a little nigher, the fire comes from the gun-barrel: with great force they meet, and action must cease, if they did not explode. So, according to Sir *Isaac Newton*, whatever attracts with the greatest force, flies asunder with the greatest force, as is above observed; which any one that tries the experiment might witness that this does, by the percussion they feel when it explodes itself.

EXP. VI.

A person electrified, standing upon Resin or Bees-wax, acts in the same manner as the metallic bodies; but the animal body being endued with feeling, upon the touch of a non-electrified person, will have the stroke as smartly as from the gun-barrel, and both feel it equally.

EXP. VII.

If wood, stone, &c. whose bodies are not so dense as metal, be electrified, you hardly feel the stroke, the explosion being weak: this effect in bodies being always in proportion to their densities.

EXP.

EXP. VIII.

A person electrified drawing the edge of a sword across the arm, leg, &c. of a non-electrified person, the latter shall feel as if he was cut, and so *vice versa* the same: and if the point be push'd by either against the other, he that receives the seeming thrust shall feel it like a small stab.

This is accounted for in *Exp.* 5. only with this difference, that the drawing the sharp edge of the sword causes a great many of the small but smart explosions; which makes it feel like notching or cutting the flesh.

EXP. IX.

The person electrified holding a sword in his hand, and the Room darken'd, a continual bluish flame issues out at the point in diverging rays; and if a Non-electric holds his hand before it, shall feel a cool blast of wind; the same is felt from the ends of small wires, points of penknives, &c.: and if the non-electrified person holds the sword, and the electrified one applies his hand, the effect is the same.

The gun-barrel, wires, &c. that are suspended, cannot have an Atmosphere so perfect as those bodies that float in Air; nor will they keep their Electricity so long. The lines they are suspended by, the wire, tinsel, &c. that touch the glass globe; and besides, the particles of *Æther* seem to have a peculiar propensity to fly through all Non-electrics that are properly suspended; and being violently push'd forward by fresh particles of *Æther* rushing on these things, must be some hindrance to the perfecting of their Atmosphere; and when the Electricity comes to the extreme ends

of the wire, &c. it cannot return back, but flies off in diverging rays of light.

EXP. X.

A person electrified pointing one of his fingers, as if to touch some warm spirits of wine held to him, or set upon a Non-electric, communicates fire to the *effluvia* thereof, which sets the whole on fire. The like may be done to all inflammatory fluids. So if the person Electrified holds the spirits, the Non-electric can set fire to it. The manner the electrical fire meets is explained in *Exp. 5.*

EXP. XI.

A man standing upon the ground takes the electrified phial of water in one hand, and the warm spirits in the other, and brings the top of the wire of the electrified phial nigh the spirits; they will take fire, and he receive a shock. As the fire is attracted from the Non-electric, the same is attracted to meet it from the Electrified body: they attract the fire of each other. In this experiment the phial of water is the Electrified body, and the spirits and person that hold it the Non-electric; and when the two electrical fires meet, they explode themselves amongst the *effluvia* of the spirits, and set them on fire. As for the shocks, they will be accounted for in *Exp. 30.*

EXP. XII.

If you draw water by a capillary Syphon, you may see it come away by drops; but, as soon as electrified, it will run off in a full stream. If the Room be dark, the water will look luminous. Much the same is to be done with a wet sponge.

EXP.

EXP. XIII.

If you stand upon a cake of resin, and touch the back of any one's hand, to shew that you are not electrified, and continue your finger very nigh their hand, while you put your other hand about an inch from the bottom of the syphon, to receive a drop of the electrified water; that instant they will receive a smart stroke on the back of their hand from your finger: and instead of holding the back of their hand, if they were to hold some warm spirits, the spirits would be set on fire, Which shews how much the water conveys it, and how active and great the expansion of Electricity is.

EXP. XIV.

If the pot and syphon be taken in the hand of a non-electrified person, it will only drop; but if it be brought nigh an electrified body it will be attracted, and run a full stream; and the Room being darken'd, the stream will look luminous, as before observ'd: but if brought to the edge of a metal plate that is electrified, the stream will not only look like fire, but you may also observe another fire coming from the plate in diverging rays to meet it, and that in a curve.

This proves the fire coming both from the electric and the non-electric at the same time; and so do several other experiments. If there are two persons, one electrified, and the other not, and each of them wet with spittle the top of one of their fingers, and approach the two fingers to within about an inch, there will issue a bluish flame from each of their fingers, and meet together: and if the fingers approach

approach nigher, the stream will become more dense, and explodes, and both persons feel the percussion. Or if they have a piece of thistle-down between them, it will be attracted by the person electrified, and then repell'd ; but, upon the touch of the non-electric person, it loses the Electricity it had received from the electrified one, so flies back to him for more ; thus imitating a shuttle-cock, in its being sent forwards or backwards by the persons that play with it. But if the non-electric person, instead of touching the thistle-down, presents the point of a needle, pin, or penknife, towards it, the thistle-down will be fixed to the electrified body, and not have power to move till the point is remov'd, and then it will be immediately repell'd as before. The same, if the electrified body presents the point ; it then will be fixed to the non-electric. It is certain that the electrified and the non-electric act much alike.

Exp. XV.

If a large plummy Feather be stuck in a cork, and set upon a stand, and so electrified, or held in the hand of an electrified person, it is surprising to see how it will become turgid, the fibres expanding themselves every way from the rib ; but if any of the electric parts in contact (let the distance be what it will) be touch'd by a non-electric, it instantly shrinks, as if sensible of the touch. Thus far it imitates the sensitive plant, but no way solves it.

The downy Feather being animal and dry, the electrical fire will not pass through it : it is not a conductor of Electricity. I have observed, that a body electrified will attract all light bodies, whether electric or non-electric ; and the tender fibres
of

of the downy Feather are expanded, and the small points thereof endeavour to recede from each other, by means of the electrical *effluvia* getting in between the plumes of the Feather; which is agreeable to what Sir *Isaac Newton* saith, when he speaks of our Atmosphere, as being nothing else but the particles of all sorts of bodies, of which the earth consists, separated from one another, and kept at a distance by pure *Æther*, as is above-mention'd: but so instantaneous is the motion, that a Non-electric no sooner touches any part that is Electrified, but the Electrical fire that instant makes its escape through the Non-electric into the floor, and mixes with the universal electrical fire; and as the electrical *Æther* that expands the Feather is attracted from among the *plumulae* of the Feather, it brings them down with it, which makes them to shrink, as sensible of the touch.

EXP. XVI.

While the Feather is electrified, it looks brisk, as if growing like a plant; and if you bring a small Needle, with your finger before the point, to within 10 inches of the Feather, then suddenly taking your finger away from before the point of the Needle, all its expanded fibres as suddenly contract, and close together.

In the experiment of the Sword, N°. 9. it was observed, that the Electrical body and the Non-electric act alike: and when the Non-electric holds the point of a Needle nigh the Feather, the electrical *effluvia* are attracted from him, through the point of the Needle, in the same manner, and feel like a cool air, as in the experiment of the Sword, whose particles being in different directions to those which expanded the Feather, repel them, and cause the tender fibres to contract.

Exp. XVII.

I have a round copper Plate, suspended by silk lines in the middle of the Room, that serves for several experiments ; and when it is electrified, if there be brought a Leaf of Gold on another Plate, and held under the copper one, the Leaf-gold will be attracted up ; and if the under plate be moved after it, the Leaf-gold will be suspended between the two plates, the proper distance being readily found, the Leaf being nighest to the Non-electric ; but by sticking a little bit of the Leaf-gold to the edge of the under plate, or by suspending of it by the point of a penknife, needle, &c. I have often found the Leaf to be nighest to the electrified body.

The Leaf-gold, in my opinion, is suspended by the mutual attraction ; the upper plate, being electrified, would electrify the Gold, and repel it ; but the Non-electric, being moved after it to a proper distance, takes off the Electricity as fast as the upper plate electrifies : so one attracts to electrify, the other to take it off ; and the Leaf has its attraction both ways. If, instead of the under plate, you hold the back of your hand, you will find the electrical fire blowing like a cool wind against it : it is plain that what fire the Leaf-gold receives from the Electrified body, it bestows upon the Non-electric.

Exp. XVIII.

I have a large Pewter plate, laid on a proper stand, and a circular Rim of Brass, with three feet made of Sealing-wax ; and when I put this Rim of Brass upon the Pewter, I electrify it by a small wire ; the feet of sealing-wax prevent the pewter plate

plate from being electrified, and support the brass Rim about half an inch from the pewter. The Rim is made in the shape of that which is thought to be described by the Earth in its revolution about the Sun : I have also some Glas balls about an inch and quarter diameter, blown very light ; and when I put one within the brass Rim, and nigh the brass, it will be attracted, turn upon its Axis, and revolve at the same time ; which, in some measure, imitates the earth in its Diurnal and Annual motions.

In this experiment is shewn the mutual attraction ; the Pewter Plate takes off the Electricity as fast as the brass rim electrifies the glass ball : if it was not to touch the Pewter Plate, it would be first attracted, and then repell'd ; and, being glass, it will be electrified mostly at that part which touches the electrified body ; it does not act like to a ball of iron or copper, &c. which would become electrified all over alike. The glass sphere can't touch the brass rim but at one point at a time ; and, consequently becoming the most electrified at that point, and in some measure repell'd ; and then a fresh point of the sphere attracted, and in the foregoing manner repell'd ; and by this means it is caused to turn upon its Axis, and to revolve.

Exp. XIX.

Darken the Room, and the glass Ball will be beautifully illuminated in its revolution, but more particularly at its poles.

Exp. XX.

I have another flattish Rim, made in the form of an egg, and with that I can make two Balls run, one within, and the other without ; one from East to West, and the other from North to South,
at

at the same time. When I first discover'd this experiment, I made the little glass ball to revolve round a large copper ball.

N. B. I could make as many of these Balls to revolve as there are Planets.

EXP. XXI.

Take a well-shap'd Rabbit's Bladder ; let it be well-clean'd, and blown up tight ; tie the end with some sowing-silk ; this I call the upper end : stick to the bottom some gold Leaf, letting a little hang down. This serves to regulate its motion, as a flie does to a piece of Clock-work ; for without this it would be only attracted and repell'd. I hung upon the gun-barrel a copper-ball, about four inches diameter ; it was hollow, turn'd smooth, and polish'd : when I electrified it, I brought a bladder in a salver, and held it under it : the Ball being electrified, and the Salver not, I suspended the Bladder, which seem'd to hang by a string of fire. When this experiment succeeds well, from the bottom of the Bladder to the Salver are seen diverging rays of fire. The ends of the Bladder I call its poles ; for it keeps turning all the time of its suspension ; wherefore it acts like the sun, revolving upon its own Axis.

The Bladder is suspended, as Leaf-gold, by the mutual attraction. If you hold the back of your hand under the Bladder, you will have a much stronger current of Æther blowing against it than in the experiment of the gold Leaf. It is surprising (some will say) how a current of Æther, setting through the Bladder, should suspend it ! I have observ'd, that the excited globe has the power of attracting and loosening this electrical fire from the watry and earthy particles that restrain'd it ;
that

that bodies electrified are endued with the quality of attracting the particles of *Æther* that are in Air; that the particles of *Æther* have undoubtedly the virtue of attracting; and as they are attracted by the electrified bodies, they bring along with them all light bodies that are in their way. In this manner I imagine the Bladder or Leaf-gold, &c. to be kept nigh to the copper ball electrified, by the particles of *Æther* being attracted in all directions to it; that the current of *Æther*, which we feel like cold air against our hands, is the Electrical fire that would repel it, and not that which did attract it towards the copper Ball: but the Non-electric, being held pretty nigh, takes off the electrical *effluvia* as fast as they come from the electrified copper Ball, and prevents its forming an Atmosphere to the Bladder, whose pulses would tend to the centre of the Bladder, and be in different directions to those of the copper Ball. I say, it prevents it from being strong enough to repel it. And here we find the *Æther* attracted to act stronger (being help'd by the Non-electric) than that which comes from the copper Ball.

As there is the force of Gravity against its suspension, if we consider the fresh influx of *Æther* continually coming into the Ball, by means of the excited glass globe; and the efflux going from the copper Ball, by or through the Bladder into the Salver, and through the Person that holds it, and so into the Floor, whence it mixes again with the universal pure *Æther*, and at the same time allow, as we have observ'd, that the copper Ball will attract the particles of *Æther* in all directions, I conclude the action of these particles, in such different directions, must be the occasion of the Bladder turning upon its own axis,

EXP. XXII.

Take a thin glass Phial, fill it two thirds with water, and let it be well-cork'd, with a wire passing thro' the cork nigh to the bottom of the Phial, leaving the upper part of the wire about six inches above the cork; then bend the wire, so that it may hang upon the gun-barrel: if you hold the Phial in one hand, letting the wire touch the globe while in motion, or the gun-barrel while electrified; by this means the water becomes electrified; and if you attempt to touch the upper part of the wire with a finger of the other hand, you will receive a strong shock at the elbows, sometimes across the breast, and sometimes all over the body; especially if the person be subject to the Rheumatism, or paralytic disorders.

EXP. XXIII.

Take a piece of gilt Leather; hang it to the gun-barrel by a couple of bent wires, and electrify it; then approach to touch it with a large Key, or any substantial piece of Metal, and the electrical fire will dart in a surprising manner on the metallic surface, and very much resemble Lightning; the Leather being a little rumpled will make it act the better.

Leather, being dry, cannot be electrified; but the Metal upon it will; which, being laid very thin upon the Leather, and being very porous withal, numbers of little parts not touching, upon the approach of the knuckle, or a substantial piece of metal, the electrical fires are attracted from both; which, meeting, explode, and are seen upon the metallic surface in numberless explosions, or little sparks of fire darting about in different

different directions, and those in a most beautiful variety of colours, which very nigh resemble Lightning.

EXP. XXIV.

Electrify a piece of gilt Leather, and a Phial of Water, at the same time ; with a pair of tongs take hold of the Phial, and with the head of the tongs touch the Leather, and there will be a very loud Report; and a Light sufficient for any body to discern every feature of those who stand nigh it, if the Room be made dark. As the other imitates Lightning, this may be said to imitate Thunder. The reason for its acting so much stronger is accounted for in *Exp.* 30.

EXP. XXV.

To the gun-barrel suspend an Egg by a small wire, and the Phial of Water at half a yard's distance from the Egg, and electrify them. Take hold of the Phial with one hand, and move the palm of the other slowly towards the bottom of the Egg; and when it comes to within half an inch of it, you will receive a smart stroke; and though you were ever so determin'd not to touch it, you cannot forbear hitting it; at which time it gives you a shock, and very sensibly affects the arms.

One might think this may help to account for Muscular Motion; for it has this effect upon the nerves, to cause the muscles to be contracted the natural way. If I hold the palm of my hand under the Egg, my muscles, being contracted the natural way, make me strike the Egg; but if I apply the back of my finger, the muscular contraction naturally hinders me from striking

EXP. XXVI.

Hang the Phial of Water at one end of the gun-barrel to be electrified. Here you may observe, that the Phial I make use of is about 12 inches high: the lower part and bottom, for this experiment, I cover with gilt Leather, almost 7 inches; so that the cork-part and 4 inches are left uncover'd. When I cover it, I work a piece of wire in with the Leather, so as to make a small loop just at bottom, which serves to hook one end of a large Jack-Chain to, of about 6 or 8 yards in length, or longer if you please; so laying the Chain round the Room, take hold within 7 inches of the other end of it, which 7 inches of Chain must hang downwards, holding your hand about 4 inches higher than the gun-barrel, as if going to touch it with the end of the Chain, which when brought within a proper distance, it will snap, and the whole Chain become illuminated.

1. This experiment is upon the very same principles, as when the whole company join hands; and it plainly shews how the electrical fire darts through the company in that experiment. 2. If one part of the Chain is laid upon the other, it will not affect any superfluous part; but takes the readiest way from the Phial to the Gun-barrel, and from thence to the Phial. 3. In the same manner, if a person stands upon the Chain, and approaches with a knuckle to the gun-barrel, he will receive a shock in the arm and legs, especially in that next the Phial: so that the nighest way is from the Phial to the feet of the person that stands upon the Chain, through them to the Gun-barrel, or from the Gun-barrel through the person to the Chain, and so to the Phial. 4. If any number of persons communicate by pieces of Wire, and one of them brings together the ends of the two pieces of Wire

in his hands; upon touching the gun-barrel he will receive no shock; the Electricity having no occasion to pass through him, as finding the readiest way through the Wires. 5. The Chain looking luminous is owing to the links, and the manner of their linking together, which does not cause them to touch; and it is in those parts which do not touch that we see the electrical fire; its explosion being confin'd to those parts only.

EXP. XXVII.

A person standing upon a cake of Refin, holding the Phial of Water by the Wire in one hand, and a Bason of Water in the other, and is electrified; another, standing upon the ground, grasps the lower part of the Phial with one hand, and endeavouring to touch the middle of the Water in the Bason with one of his fingers of the other hand, or with a large Key, they both receive a shock.

N. B. It is to be observ'd, that, at the approach of the Finger or Key to the Water, the Water rises up in a small cone, and a snap is to be heard, and the fire to be seen, especially if the Room be dark.

Query, Whether the Water's rising up in a small cone might not help to account for the Water-spouts at sea?

EXP. XXVIII.

If a Lady electrified stands upon Refin, and holds the Phial of Water by the Wire in her hand, and a Gentleman grasping the lower part of the Phial, as he stands on the ground, and if both endeavour all that is in their power to salute, they cannot: no sooner do their heads come within about half an inch of each other, but they meet

with a mutual rebuff, that will cause them to fling their heads back much quicker than they endeavoured to meet. They are very apt to clap their hand to their face, as if it were to feel whether their head be in its place; for it makes it ring, and causes them to forget that they were going to salute. This shews the effect it has upon the nerves to make the muscles contract the natural way; for the chief muscles of the neck are in the back part of it.

EXP. XXIX.

Get four Pillars, about fourteen inches high, fix'd at the bottom to a board twelve inches square, to keep them firm; upon the top of the Pillars lay two pieces of Wood across in right angles; get 5 small Bells, hang the largest where the two pieces touch that are laid across upon the top of the Pillars, which is the centre, by a piece of silk line, to keep the Bell about 3 or 4 inches from the Wood; the other 4 you must hang round the Centre-Bell by small Wires; the bottom of each of these Bells must be about an inch and quarter from the bottom of the Centre-Bell: these Bells are to be without Clappers; but something like a Clapper must be hung by sewing silk, between the central and each of the other 4 Bells. The Clappers and the 4 Bells may be hung by making a sort of loop to the silk, and the wire by which they are supported, that they may be moved nigher to or farther from the Centre-Bell, as requisite; then convey a Wire to the Centre-Bell, which you electrify by itself, because it is suspended by Silk; and the Clappers being hung by Silk, will be attracted by the Centre-Bell electrified, and repell'd against the 4 outward Bells, which (being hung by Wire) takes off the Electricity from

from the Clappers, and they are again attracted and repell'd by the Centre-Bell, &c.

EXP. XXX.

Let one take hold of the electrified Phial of Water pendent to the gun-barrel, the whole company joining hands, the last having one hand at liberty, with which he is to attempt to touch the gun-barrel; but at the approach of his finger, or one of his knuckles, to within half an inch of the gun-barrel, the whole company receives an instantaneous strong shock. This experiment may be tried upon any number of persons at once.

To help to solve this experiment, I am going to mention another.

If a person stand ready with the Left-hand to touch the gun-barrel, &c. with one of his knuckles, and a second person put one finger of the Left-hand on the back of the Right-hand of the First person, and in the same manner a Third on the back of the Right-hand of the Second person, and so on, and the First person approach his knuckle towards the gun-barrel, he receives a smart stroke as usual on the knuckle; but all the rest, at the same instant, feel a sensation like a strong pulse, beating against the finger of their Left-hand, and in the back of their Right-hand; except the last person, who is hardly sensible of it.

In this experiment the whole company is affected, though but weakly, (they receiving the repulsive force but one way): but, in this experiment, we find the Electricity flying through the whole company, before it gets into the floor. But if the first person grasps the Phial of Water, and all the company join hands, the last person of the line approaching with one of his knuckles
towards

towards the gun-barrel; at that instant all the company receive a strong and surprising shock.

I have observed, that all the fire does not come from the Electrified body, but it attracts fire from the Non-electric; and at the same time fire comes from the Electrified body, to repel it: when these two fires meet (if the expression be allow'd me) the particles being the same. *viz.* the Electrical fire or *Æther*, only attracted in different directions, which cause them to repel one another, I say, when they meet, if the Electrified body has not power to repel the Non-electric, it causes the explosion which we hear, and feel the violence of when it flies asunder. But to the point; when the last person approacheth the gun-barrel with his knuckle, the company begins to attract the Electricity from it, and that from them, for if we consider, the whole company joining hands acts as one body, and, at the same time, the electrified Phial begins to exert itself, and to attract the *Æther* from the Company towards it, and the Company to attract the *Æther* accumulated in the Phial towards them. In this position the Non-electric attracts every way from the Electric body, and the Electrified body every way from the Non-electric, and the Electricity ready to break forth into action, upon the nigher approach of the knuckle like gun-powder, which the more it is compress'd the more it explodes. Upon the nigher approach of the knuckle, the repulsive force breaks through the Phial (it being of thin glass), and with violence repels the Electricity through the whole company one way, and the repulsive force darts through the company the other way from the gun-barrel; so when the particles of *Æther* meet in different directions, they always repel each other; and in this experiment
they

they meet in each person that is in contact, and the repulsive force is felt within them, which causes that surprising sensation, which they all feel at the same instant.

EXP. XXXI.

Turn a piece of pumice-stone round, and as smooth as possible, making a hole in it for a wire to be thrust through the centre, to serve as poles to turn it by; dip it in water, then stand upon a cake of Resin, and be electrified, turning the pumice gently upon its poles; then let a Non-electric be held near the ball electrified, the water on the surface will be seen to rise always towards the Non-electric. This experiment might help to account for the Tides; which was the opinion of Mr. *Wilson*, who discover'd this experiment, and that of the silver Leaf.

EXP. XXXII.

Suspend a copper Plate of about 10 inches diameter by silk lines, and electrify it; get a Pewter Plate sixteen inches diameter; fix it upon a stand that may be moved up and down upon occasion; place it under the copper Plate, move the stand upwards to within 6 inches of the Copper Plate; then if you set on the Pewter Plate upon their feet some grotesque figures, such as Harlequin, Punch, Pierrot, &c. drawn upon and cut out of very thin paper, you will have a delightful entertainment in dumb shew, the figures dancing in a brisk manner, and as if they had some design in what they were about.

This is really a diverting and surprising experiment; for each of these little figures form to themselves an Atmosphere. of an elastic nature.

which prevents their touching each other ; and if you move your hand towards them, they seem to be pushed from you, by that time you come within two inches of them.

This is agreeable to Sir *Isaac Newton's* Æther, which he says keeps all the particles that impregnate the Air at a distance from each other ; but if one of these little figures, full as tall as the others, should happen to be much lighter than the rest, it will be attracted and repell'd, and cannot be at rest till it becomes join'd to another : upon its being attracted to the Upper Plate it becomes electrified, and often by that means will attract another to it. There is also an Atmosphere immediately form'd to them both ; which makes it something resemble matrimony, for they dance as one body, as long as their spirits will suffer them.

A silly fellow, that advertis'd against this experiment, after a fulsome puff of himself, says as follows :

‘ Where it is presumed no late improvements will be expected (no, I believe not—of *his own*) to be added to the course, but such as, in their own natures, afford matter for the most solid Inquirers ; such as may probably lead us to the cause, and thereby point out some grand and important effects, instead of those Emblematical dances the ignorant boast of, which tend to debase the noblest principle in nature, by bringing its properties into contempt and ridicule.’

Why ? because they are diverting ? Does not the mind require some relaxation ? Would he have others as dull as himself ? But the true cause, as I take it, was my refusing to shew him the experiment of the Chair and Crown ; and telling him

the last experiment I had shewn him as his own, making the greatest puff of it, and calling it *His Electrical Orrery*. He is, in his *own* opinion, a Great Philosopher; but can't persuade any body else to think so; people being obstinate, and of another opinion.

I expect that some of those ingenious gentlemen, that sell Twelve-peny Chops of Electricity as well as myself, will advertise against me and my book; but I am contented, as it may be a means of sending me customers, both for the Book and Electricity.

EXP. XXXIII.

The method I made use of to separate the Electrical fire, or Æther, from those particles that clogg'd it, was, by getting a Glass Receiver made in the shape of a Crown: the top of the glass Crown had a neck like to the end of one of the glass globes which we make use of; to this neck I fixed a Cap of Brass, with a stop-cock in the shape of a cross; in the inside of the Glass I put a Tin Plate, cut round like the top of the Glass, and dividing the Tin Circle into eight parts; I had the Tin cut in points like the middle part of a fleur-de-lys, and turn'd downwards, with an intent, that when the top was electrified, these points might convey the Electrical fire to the bottom, which is a Plate of Brass, and acts as a Non-electric, and attracts the Fire from the Top Plate, which is to be electrified; then fixing it to an Air-Pump, I exhausted all the Air I could out of it. I had a Chair made, with a Back to move up and down at pleasure; from the top of the back was a projection, of about 9 inches, over the seat of the Chair, wherein a circular cavity was made to receive the Bottom of the Crown; and when any person sat in it, by means of the Back moving up and down,

I could place the Crown on the head of the person sitting in the Chair; over the top of the Crown I hung a Plate of Metal, about five inches diameter, to move up and down like a chandelier: this Plate I could electrify by a wire I convey'd to it; so when I perform'd the experiment, I mov'd the Plate so nigh the Crown, that, when electrified, a continued stream of Fire would appear between the Plate and Crown, and the Crown look luminous, as if almost fill'd with fire, by numberless rays of light darting in different forms from top to bottom in a glorious manner.

I must here observe, that the Person and Chair are not electrified; there being no resinous body between them and the boards; yet the Person sitting in the Chair will receive so much of the Electrical fire, that it shall be very sensibly both felt and seen by any one that attempts to touch him.

The first time I made this experiment was about 3 years ago; but once, as I was exhausting the Receiver, it burst, and cut my face, which deterr'd me from going on with it; tho' at this time I have a proper *Apparatus* to shew this experiment, which intirely destroys the doctrine of *Capsula's* or Cases, by some asserted; as imagining that the Electricity does not pass through the Body electrified; but it is very plain that it does; for otherwise it could never be convey'd into the exhausted Glass Receiver.

EXP. XXXIV.

If you apply a common Loadstone arm'd with iron, or one of Dr. *Knight's* Artificial Magnets, to the gun-barrel when not electrified, by its attraction it adheres to the barrel; and to the end of the artificial one, a Key, &c. then electrify the gun-barrel,

gun-barrel, and you will find the Electricity will not interfere with Magnetism. The Magnets, both real and artificial, becoming electrified, not only admit the Electrical fire, but attract and repel in all directions all light bodies by the power of Electricity; and at the same time the Electricity no-ways impedes the action of the Magnet.

EXP. XXXV.

At the beginning of this book, the reason that I gave why Glass should have the power of attracting the Electricity was, that the chief composition of Glass was Fire or Sulphur; which made me conclude, that a Globe made of Sulphur only would serve to perform the electrical experiments as well as a Glass one: whereupon I made a Globe of Sulphur about 14 inches diameter, and found it answer exceeding well, and better than Glass. If a person holds all the fingers of one hand over the Sulphur-Globe, when excited, and even at three inches distance, there will be streams of fire attracted from all the pores of the fingers; and as it rushes upon the globe, it makes such a hissing noise, and gives so much light, that really it is enough to startle the person that tries the experiment.

I have only observed this difference as yet between the Glass and Sulphur Globes, that if the Point of a Sword or Wire, &c. is held by a person electrified by a Glass Globe nigh to a Non-electric, a bluish flame will issue from the point: but, if held by the Non-electric towards the Electrified person, then the point of the Sword or Wire becomes only illuminated; but just the reverse, if the same experiment is tried with the Sulphur Globe, which cannot be excited to any height by hands, or leather cushion as the Glass Globe

is ; but may, by means of folded linen between the hands and globe, be excited to a very high degree.

A Candle being just blown out, and held between an Electrified and a Non-electric body, so that the electrical stroke might pass through the snuff, it will light up the Candle.

N. B. I always succeeded in this experiment when I made use of the Sulphur Globe.

Our experiments do not succeed well in damp, foggy, or hazy weather ; the Electrical fire being then so much employ'd in saturating and supporting the Atmosphere, that we can attract but little Electricity from the Air ; besides the watry and earthly particles, which at those times the Air is charged with, settle upon our silk lines and supporters, and by that means cause them to convey part of the Electrical fire into the earth, instead of repelling it.

When vapours, exhalations, &c. that are attracted into the Air, are driven by the winds in greater quantities than ordinary over that part of the habitable globe which we reside on, then we say it is gathering for Rain. The reason of my saying, the watry and earthly particles are driven together by the winds, is, that when we see such heavy clouds that seem ready to deliver their loads in kind and friendly showers, and sometimes in tempestuous ones, if a strong wind arises, we find they are removed by the winds from over the threatened place to another, and there descend in rain. It is observed of those days, when the Atmosphere is fullest of matter, that the pressure of the Air is least.

I have

I have observed, that the *effluvia* of the Earth being attracted into Air become electrified, and the particles of these *effluvia* repel each other; and when the electrical Æther, which is diffeminated throughout the universe, becomes clogg'd by the *effluvia* of the Earth over any one part of this globe, it cannot act with so much vigour as it did before, the spring centrifugal, or repulsive force, being weaken'd. But when Æther is overcharg'd by the *effluvia* of the Earth, and no longer able to support those *effluvia* against the Earth's attraction, they then descend to the earth, to assist in the new generating and nourishment of Animals and Vegetables; and while they descend to the Earth in one part, they are attracted from the Earth in another, to keep up the round of Generation.

We have had an account of one cured of a Paralytic disorder, by being electrified; and of a woman cured of an Apoplectic Fit, who was electrified and blooded.

One of my acquaintance, who had a violent Crick in his Neck, I electrified, and gave him a shock or two in the head, which immediately cur'd him,

Another that had been terribly troubled with the Night-Mare, or being hag-ridden, so that he had not slept for 7 or 8 nights, and at times, when he was likely to go to sleep, he would start from it, and be in all the agonies imaginable; but, upon his being electrified, and going through some of the shocks, he went home, and slept as well as ever. I have seen him several times since, and
he

he informed me, that he has not had any return of it; but, if ever he should, he would be electrified again.

The CASE of John Dew, written by himself.

May 26. 1747.

ABOUT nine months since I was playing at Billiards, and blew one of the balls out of my mouth for a considerable time, as nigh as I can judge about two hours. Afterwards, I was not very well all that day: and to my surprize, in about a week's time or less, I had a small swelling on the right side of my Groin; which I did not take a great deal of notice of, till about three months afterwards I perceiv'd it to grow somewhat bigger, though with little or no pain; but, fearing bad consequences might happen in time, I applied to a person of judgment, who told me it was a wind-rupture; upon which I bought a truss, and applied it to the part affected. When I had worn it about two months, I found the wind began to fall into my *scrotum*, which at first was not very big; but finding it to increase more every day, even to a very large size, I began to be in a very great concern about it. When I was us'd to squeeze my *scrotum* with my hand, I could feel the wind come into my belly, which caus'd me to belch; but if it happen'd (as it sometimes would) that I could not break wind, it would instantly fly into my head, and make me so giddy, that I have hardly been able to stand; sometimes it would settle in my breast, or under my ribs, which occasion'd great pain, and my *scrotum* used to be so fill'd with wind as to be painful in walking. I having heard of the surprising experiments in Electricity, had the curiosity to go to Mr. *Rackstrow's* in *Fleetstreet*,

Fleetstreet, on *Friday* the eighth instant, to see them perform'd; where I received but one shock, which had an emotion on my spirits all the same day; and at night, putting my hand down to my *scrotum*, to my surprize I found all the wind diffipated from that part. I told a person belonging to Mr. *Rackstrow* of the effect it had on me; he advised me to come again to be electrified; but, being obliged to go into the Country, the *Tuesday* following, I walked very nigh an hundred miles by *Friday*, when I return'd again to *London*; and the next day, which was the 18th instant, I went to Mr. *Rackstrow* again, where I received the shock 4 times. This put me into a violent sweat. Ever since, blessed be God, I have continued in a tolerable state of health; and now at this writing the wind has quite left me. This I attest to be true.

J. D.

This person receiv'd the shock standing upon the Chain that I hung to the bottom of the electrified phial of water, by approaching his knuckle to the Tube electrified, to make the circle good, and at that time the Electricity must pass through one of his thighs, and possibly might affect the ailing part; the fluids where the Electricity passes through being put into a violent agitation, the particles being electrified repel each other with violence, and, consequently, may not only break the bubbles of wind, but quite remove the cause; as I have found by experiments upon them that have been afflicted with the Gout, or Wind in their Stomach, who, upon their receiving the shock across the breast, have been immediately cured.

It has been proved by experiments, both at home and abroad, that Electricity is not only Light, but that it flies with the same rapidity. Both antient and modern philosophers agree, that æthereal Light or Fire is disseminated throughout the universe, that the particles of all bodies; and Air, are kept at a distance by it, that the particles of this Fire, being clogg'd by earthy and watry particles, become less active; but such earthy and watry particles as cohere with Æther, more active; its attractive and repulsive force, with its great expansion, &c. convince me, that Æther and our Electrical fire is one and the same thing; and farther induces me to believe it to be the very same which *Homb-berg* means by his Sulphur, and Sir *Isaac Newton* by his Acid; and that the ancient doctrine of elementary Fire will be re-established.

I know I am pulling on myself the indignation of some; but I believe, if Sir *Isaac Newton* was alive, to see the experiments we now make in Electricity, he would allow of Elementary Fire himself. In the account we had from Mr. *Le Monnier*, it appears that he had kept a bottle of water electrified 36 hours: I have kept one for ten hours. There is but little motion to create Fire in this experiment; and I cannot imagine that we can add one particle to pure Fire, or destroy one.

I have found out some experiments myself relative to the Planetary System; such as the glass Ball which turns upon its Axis, and revolves at the same time, which in some measure imitates the Earth in its diurnal and annual motions. 2. A small piece of Leaf-gold, which I suspended to the

the

the edge of a Copper Plate, revolved round it like a Comet. 3. A Rabbit's Bladder, which, I suspend, will keep turning upon its Axis like the Sun, or one of the fixed Planets. In short, I find that all bodies in the state of suspension, have a tendency to revolve, and turn upon their Axes : which is enough to make us think that this Electrical Fire is the cause of the Planets being kept in their places to turn upon their Axes and revolve.

If this rude essay of an Unlearned Fellow should give some hints to such as are willing, and capable of writing upon this subject, and some amusement to others, whose hands it may happen to fall into, I shall be well pleased : if not, I shall be heartily sorry for the trouble I give my readers.

F I N I S.

B. RACKSTROW,

*Figure maker and Statuary, at Sir Isaac
Newton's Head in Fleetstreet, London,*

TAKES off Faces from the Life, and forms them into Busts to an exact Likeness, and with as little Trouble as fitting to be shav'd: Makes all sorts of Figures in Plaster, with Ornaments for Doors and Chimney-pieces in the neatest Manner, to represent either Marble-Stone or Terraeotta.

N. B. He likewise makes and mends leaden Figures, Vases, &c. for Gardens and Fountains,

*He also takes this Method to acquaint the
Curious,*

That he has begun to exhibit his Electrical Experiments, such as the Chair of Beatification, which proves, beyond Contradiction, that Electricity passes through the Pores of all Bodies, with its setting Fire to Exhalations, Vapours, and all inflammatory Fluids; which assists in demonstrating the Similarity of Electricity to Lightning and Thunder, with all the other most curious and extraordinary Experiments invented; either abroad, or in this Kingdom; with his own Experiments relative to the Planetary System, and the Sun's illuminating the Earth. But he begs to be excus'd exhibiting to less than Three at a time; and, if requir'd (upon Notice given the Night before) the Experiments shall be perform'd by a Sulphur Globe, of about fourteen Inches Diameter, which acts better than Glass. Price One Shilling each Person.

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A Treatise on the Circulation of the Blood, and the Communication between the Mother and the Fœtus; with an Explanation of the Figure of an Anatomy, wherein the Circulation of the Blood is made visible thro' glass Veins and Arteries, with the Action of the Heart and Lungs; as also the Course of the Blood from the Mother to the Child, and from the Child to the Mother; by which means any person, tho' unskill'd in the Knowledge of Anatomy, may, at one View, be acquainted with the Circulation of the Blood, and in what Manner it is performed in our living Bodies. Adorned with a Copper-Plate; wherein the Structure of the Heart is design'd, and the glass Vessels exactly represented in their Order, as they are in the Figure, to which they are to be referr'd.

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To the Honourable the
MEMBERS of the *Academy*
of *Sciences* at *Bordeaux*.

Learned Sirs,

HAVING found, by an Advertisement in one of our public Papers, your Desire of knowing the different Opinions of People upon the Similarity of Electricity to Thunder and Lightning, I humbly offer my endeavours in the manner following.

Sir *Isaac Newton* says, that there are always sulphureous exhalations ascending into the Air, when the Earth is dry; there they ferment with nitrous acids, and sometimes take fire, and generate Thunder, Lightning, &c.

In shewing some experiments in Electricity, I once made use of a phial which before that time had oil of vitriol in it; I put water into it, and electrified it as usual; I used it about a day and half; in which time no accident happen'd; and then, on a sudden, as I was shewing the experiments, it exploded with great violence, and a loud report, and with a flash like Lightning; tho' at that time, and for a considerable time before, no one had touch'd any thing that was electrified. The bottom of the phial I found in a perpendicular, under the place where it had hung; the cork and wire

remained hanging in their places ; but all the other parts and the water were forcibly repell'd all over the room. The pieces of glafs I found upon the Drawers, Table, and Chairs, that were in the room ; and obferving where my cloaths were wetted by the water, I found the colour difcharged ; which made me recollect there had been Vitriol in the phial.

When I confider, that the compofition, or contents of the bottle, was a good deal of water, with a very little Vitriol or Sulphur, which, with the Electrical fire accumulated therein, had caufed this great explofion ; I imagined it not improbable, that *Æther*, meeting with the nitro-fulphureous and watry particles in the Air might be the caufe of Thunder and Lightning. I believe, that, by our difcoveries in Electricity, we may account for feveral *phænomena* ; fuch as the Northern Light called *Aurora Borealis*, Exhalations, Ebbing and Flöwing of the Tides, fubterraneous Fires and Vulcano's, fuch as *Ætna*, *Vefuvius*, *Hecla*, &c. Earthquakes, muscular motion, and the Winds.

The effects of Thunder are fo like thofe of gunpowder fired, that Dr, *Wallis* thinks we need not fcruple to afcribe them to the fame caufe ; the compofition of gunpowder being Nitre and Sulphur ; Charcoal only ferving to keep the parts feparate, for the better kindling.

We may conceive, from what Sir *Iſaac Newton* afferts, that there is a convenient mixture of nitrous and fulphureous particles in the Air ; which being fet on fire, there follow both noiſe and light, as in the *phænomena* of Thunder, &c. and will run in fuch directions as the exhalations lead to, as is

I shall now prove, that Electricity is capable of setting those nitro-sulphureous particles on fire, and am very certain no one can prove that they can be fired without the assistance of the Electrical Fire in the Air.

Electricity will not set fire to bodies that are fixt, but to such as are in a volatile state, as all inflammatory fluids are; and a Candle just blown out being held between a non-electric and an electrified body, so that the electrical Stroke may pass through the snuff, the Candle will be thereby re-lighted.

Mr. *Watson* made an experiment with File-Dust and Vitriol mixt with Water in a bottle, which caused an ebullition and heat; and if a person electrified holds his finger to the mouth of the bottle, the exhalation or vapour that arises takes fire and explodes (and would burst the bottle, were it not to have a wide mouth) and so burns like a vulcano. I am well aware it may be objected that such or the like compositions will take fire of themselves. My answer is, I have tried several times the composition here spoken of, but never found that it did take fire of itself; tho' it never failed taking fire upon the approach of an electrified body; even of Water, when electrified, and suffer'd to run into it: but if any such should take fire of itself, can any one assert that it would do so, without the assistance of the Electrical Fire in the Air?

The followidg experiment will prove in a stronger manner the firing of sulphureous exhalations by Electricity, which was told me by Mr. *John Pinchbeck*, viz. that at *White-baven* in the County of *Cumberland*, the sulphureous exhalations arising

from a Coal-mine, and confined to pass through a tube, being set on fire, serve as a Light-House; and it is a generally received opinion, that it would be fatal to that mine to carry a lighted candle into it; but the practice there is to make use of steel, formed like a grind-stone, being swiftly turn'd upon its axis, and, at the same time, a piece of flint applied thereto causeth such a number of sparks to fly off, as to afford the miners sufficient light to work by, those sparks not being capable of setting fire to the exhalations, &c. as Electrical or other flames would do.

One of *Coborn's* grenades I filled with pit-coal broken small, and fixed to it a small gun-barrel, and at the other end of the barrel a small pipe (a tobacco-pipe will do) and to the end of the pipe tied a bladder, having taken care that all the junctures were well luted, that when the *Coborn* was set on the fire, the sulphureous exhalation might pass through the tubes, and fill the bladder: I then took the small pipe and bladder from the barrel, and stopped the end with wax; and, when minded to try the experiment, I took away the stopper, and as the exhalation issued from the end of the pipe, applied it to a body electrified, and it took fire from the electrical stroke, and burnt like a candle, but, upon stopping it, it went out, and served me for the same experiment several times.

It is said, that at *Flasblun* in *Sweden*, noted for copper mines, the mineral exhalations affect the air so sensibly, that their silver coins are frequently discolour'd in their purses, and the same effluvia change the colour of brass.

Mr.

Mr. Boyle was assured, by a gentleman who profess'd some ground wherein were several veins of metals and other minerals, that he had frequently seen pillars of fume ascending thence; that in *Carniola*, *Campania*, &c. where there are mines of Sulphur, the Air at certain times becomes very unwholsome; that mines near the *Cape of Good Hope* emit such horrible fumes from the Arsenick in them, that no animal can live near them, and that such as were at any time opened, were obliged to be immediately closed again. From whence it is evident, that at all times there are immense quantities of exhalations, vapours, &c. attracted from the earth into the Air; where, becoming saturated with electrical Æther, those particles acquire that centrifugal force which Sir *Isaac Newton* attributes to Air.

If you cut some Gold or Silver Thread, Tinsel, or very fine Wire, into pieces of about half an inch long, and hold them on a salver under a metal Plate electrified, they will be attracted up; but, meeting with the body electrified, a number of small explosions will be created, and they become electrified, and with greater force repell'd than when attracted up to the electrified plate; and, undoubtedly, if the motion of those pieces of Wire, &c. was not so quick, but would give time, so that, by the application of one's hand, we might feel the electrical blast, as we do from the points of penknives, needles, &c. we should see the same bluish flame as from them.

The exhalations of all such Non-electrics as Metal, being attracted into Air, and there meeting with such sort of exhalations as themselves (already saturated with electrical Æther) cause such innumerable small explosions, that the part of the
heavens

heavens where they are seems to shiver and shew those streams of flashing Lights which are called *Auroræ Boreales* or the Northern Lights; the North abounding with metallic Mines, &c. more than any of the other parts of the globe. In the same manner Thunder and Lightening may happen, when the exhalations are in greater quantities, and more dense.

Let us suppose a column of mineral exhalations, or aqueous vapour, ascending into Air by the sun's attraction and subterranean heat, assisted by the æthereal or electrical Fire, which is ever restless, and pervading the pores of all bodies, and this I conceive to be the Spirit of the Air, which assists in the production of all things, according to the *Matrix* or different pores of Earth it uses to meet with; for, having the quality of attracting from the Earth the effluvia of each constituent part thereof, it gives to them fluidity, and conveys them along with it; and as it passes through the pores of terrestrial bodies that have lost their volatile part, these bodies will attract to themselves each their proper effluvia, and fix them; which has been observ'd in a great many different bodies, and particularly in different Salts, which having had their Spirits distill'd from them, and they exposed to the air, have in a short time considerably increased in their weight, and fresh Spirits drawn from them, and so for 8 or 9 times successively.

But as to the exhalations, &c. ascending into Air (from which I have digress'd) they meeting with a Cloud saturated with electrical Æther, which Cloud assists in attracting the effluvia towards it, as light bodies are attracted by a body electrified; and, though brought by the electrical
Fire

Fire in the Air towards that body, are not filled therewith, until they touch the body electrified, and then are immediately repell'd, the effluvia ascending to meet the electrified Cloud in a fainter manner attract the Cloud; but, when they meet, the attractive force ceaseth, and then the repulsive power begins; which causeth that flash of Lightning, and consequential noise of Thunder; the Cloud, acting stronger than the Effluvia, darts its electrical or æthereal Fire through the exhalations, &c. to replete them therewith. But if these exhalations, &c. upon their approach to the saturated Cloud, should likewise reach the Earth, then, consequently, the Lightning would dart to the Earth, and might destroy whatever Animals, Vegetables, &c. should happen in its way.

I shall now endeavour further to shew the Similarity of Thunder and Lightning to Electricity. The surprisingly violent shock that is to be given (even in a degree greater than they can well bear) to any number of persons at once, is sufficient to satisfy us, that the Electricity, passing through a Tree in the same manner, must shock the Fluids thereof as it does the animal body. If we could collect a great deal more Electricity, we might split the Tree, as we burst the vessels in Animals kill'd by Electricity, whose bodies look livid, as when kill'd by Lightning.

Mr. *Watson* communicated the following experiment to me, and shew'd me such a large Glass as I am about to describe; but his was broke. He took the hint from Dr. *Bevis*, who, for the same experiment, made use of a flat Glass gilt on both sides, excepting a margin round (no matter what form). This Glass that was shewn me was blown

very thin, in the shape of a cylinder like a confectioner's, and open at top, and gilt both on the inside and outside to within two inches of the top. I cover'd mine (which was about twenty inches high, and ten diameter) with gilt leather, as high as it was gilt; which preserv'd it from breaking, and made it act the stronger. The metal within such a Glass as I have described, when electrified, will act with greater vigour more than 25000 times its own weight of iron File-dust in bottles electrified; which proves that it is from the number of the points in contact that it comes to act so strongly, and not from the quantity of the metal. I let a piece of Chain hang down from the tube which I had electrified, to electrify the metal within the Glass; I made use of another piece of Chain, about ten yards long, one end of which I laid under the bottom of the Glass, and the other end I held to the tube electrified, to cause the explosion, which was as loud as the report of a Pistol, and the flash of light so very bright as to dazzle the eyes of the beholders; the whole Chain that led the electrical explosion was not only illuminated, but darted Fire in most directions; the report, though as loud as that of a Pistol, was not so short, but more like that of Thunder. The first time I tried this experiment, I thought it had broken the Glass to pieces. In places where the Chain communicated, I have in a proper manner, in one place, put warm Spirits of Wine, in another File-dust, Vitriol, and Water mixt together, some Oil of Turpentine in a third, and in trying the above experiment, all these different things would take fire together; which is a proof, that Electricity is capable of setting fire to all sulphureous Exhalations or Vapours in the Air; and those combustible Clouds taking fire one after the other,

their different explosions cause the successive noise of Thunder.

I must here observe, that Water is as great a conveyer of Electricity as Metal, and consequently may, in the producing of Thunder, have the same effects. Such experiments have been tried by the sides of and across great rivers, and the Water has been found to convey the Electricity for several miles together as well as an Iron Chain, the persons trying the experiment receiving as violent a shock.

To give my opinion in what manner that kind of Thunder, &c. is generated, which proves the most destructive.

I first suppose a Cloud form'd principally from Mineral Exhalations, or from Vapours ascending from Waters, and that it is become saturated with electrical *Æther*; wherefore, the better to convey my meaning, I term it an Electrified Cloud, it being a non-electric become electrified (as my electrified tin tube, and the chain hanging from it into the glass to electrify the metal therein); and at one end of this Cloud, between it and the earth, a sulphureous one annexed, which I call an electrical Cloud; Sulphur being an originally-electric; the particles of Sulphur not suffering the Electricity to pass through (but all light bodies, whether electrical or not, will be attracted into Air): wherefore these electrical Clouds act in the Air as the cylindrical glasses do in our experiments, preventing the body electrified and the non-electric from touching. Secondly, let us suppose a high hill, whose bowels abound with metallic Veins, &c. and Water continually running down from thence into

a river at the-foot thereof ; and that Vapours are ascending from that river, and approach to one end of such an electrified Cloud as is before described : let us suppose also, that the end, where the sulphureous Cloud intercepts, hinders the Vapours of the Water from touching the electrified Cloud ; in that case such an intervention will consequently prevent the explosion thereof. In the same manner the cylindrical Glass acts, by preventing the Electricity from passing through the bottom thereof into the Chain laid under it : and we may reasonably allow, that, at the same time that the Vapours are arising from the Waters, the Exhalations may be attracted from the Metals, &c. and are ascending into Air from the top of the mountain, and very probably from the river even to the top of the hill, either from the Water running down the hill, or from the veins of Metal therein, Exhalations, &c. may be gliding up the hill, in order to join the Exhalations ascending from the top thereof, which would carry on the communication between the bottom of the Vapours arising from the river, and the Exhalations arising from the top of the mountain : but if there was no Exhalation, &c. arising from the declining part of the hill, the veins of Metal, &c. in the earth, or the Water running down the hill, would make the communication good ; even dry Land would convey it, but not with so much strength.

It has been found by experiments, that the large quantities of Water in rivers no-ways hinder the circle from being made good ; for Electricity will always pass the nighest way. The Exhalations, &c. ascending from the top of the hill, and approaching that end of the electrified Cloud, where there is no sulphureous Cloud to prevent their touching,

touching, causes that dreadful explosion called Lightning and Thunder, with all its terrible effects.

The Chain that has one end under the cylindrical Glass, having the other end applied to the Tube electrified, acts as the Exhalation, &c. ascending from the hill and water; the upper Cloud saturated with electrical Æther (as before observed) acting as our Tube electrified, and being disturb'd at its end by the approach of the Exhalation, &c. as our electrified Tube is at the approach of the end of the Chain; for when the attractive force ceaseth, the repelling power begins, and, of consequence, must act stronger from the saturated Cloud, than from the effluvia of the earth ascending to it; so darts the electrical Æther from both ends of the Cloud vehemently (in order to keep up the æquilibrium) into the Exhalations and Vapours which arise from the Mountain and River. For I suppose the sulphureous Cloud no longer capable of preventing the Electricity from breaking through (when it exerts itself) than our Glass in the experiment where the shock is given; this æthereal Fire being led in whatsoever direction those Exhalations, &c. are in; may consequently pass through Trees or Animals, &c. they all being great conveyers of this electrical Æther. This Fire, in its progression through the effluvia, electrifies (if the expression be allow'd) each particle thereof; which causeth those particles to fly asunder, and become Air: but especially the hardest of the effluvia; for Sir *Isaac Newton* takes true and permanent Air to be form'd from the Exhalations raised from the hardest and most compact bodies. And as this æthereal Fire is darted from the electrified Cloud at one end, it passes through

the Exhalations, &c. raised from the top of the hill, and so downwards; and from the other end of the Cloud through the Vapours attracted from the water, and so up the hill, in order to saturate all the effluvia with electrical Æther, whose particles, meeting in different directions, repel each other; whereby the particles of the effluvia are made to fly asunder with such astonishing violence, as to rend rocks and trees, burst the vessels of animals, &c.

Metals, and some Minerals (which are great conveyers of Electricity) being generally found in Hills more than elsewhere, I have chosen to suppose a high hill in the foregoing pages on that account; and from an apprehension, that what I have there said may thereby be more easily understood; for the same effects may be produced on level ground.

As to other effects of Electricity similar to those of Thunder and Lightning;

1. The electrical stroke is always strongest where it finds the greatest resistance, and which is always according to the density of the body acted upon. The strong texture of the bones, nerves, and blood-vessels, making the greatest resistance, suffer the most; but it passes more easily through the pores of the Flesh. In like manner, Thunder and Lightning will destroy the Bones, and burst the Vessels of animals, without doing any manifest hurt to their Flesh.

2. When any number of persons join hands, in order to receive the electrical shock, if a stander-by puts his hand upon the shoulder, &c. of any one of such

such persons when the experiment is tried; it will not have any effect upon such a stander-by; the electrical Fire always taking the highest way: and, from considering the experiment of the large cylindrical Glass, and what more has been said to that purport, it seems probable Thunder and Lightning may happen without any sulphureous matter being set on fire, even so as to have the power to destroy Houses, Trees, Animals, &c. as before observ'd; and being led in the direction of the Exhalation, &c. where two men are, kill one, and spare the other, though they should even touch each other.

3. Electricity will set fire to all inflammatory Exhalations or Vapours (as before observ'd), and they to whatever is combustible; and no doubt but there is always store of sulphureous Exhalations and inflammatory Vapours in the Air, that may take fire at these grand explosions of Lightning and Thunder, which I have been treating of; therefore may set fire to Houses, Trees, Stacks of Hay, Corn, &c. or even melt Metals. The electrical Æther abounding with the subtil parts of terrestrial salts, when led through any matter wherein Metals are contained, may, at the time of Lightning, &c. convey the most powerful of those salts into the pores of such Metal, as it passes through them. And this considered seems to account for that surprising effect of Lightning that has destroy'd a Sword, without hurting the Scabbard that contain'd it. And not unlike to this, in its effects, is *Aqua fortis* (which is drawn from some of the before-mention'd salts), which spares soft bodies, and destroys hard ones.

With me there remains no doubt, that farther proof of the similitude of Electricity to Lightning,
 &c.

Ex. will be often obtained and, clearly manifested from future experiments : and if I shall have the good fortune to have made out satisfactorily what I am firmly persuaded is true, *viz.* that Lightning and Electricity are the same Fire, or to have furnished our hints for others of greater abilities to improve upon, I shall have gained my whole aim, and sit down well pleased with my labour ; having the honour to subscribe myself,

Gentlemen,

Fleetstreet, London,

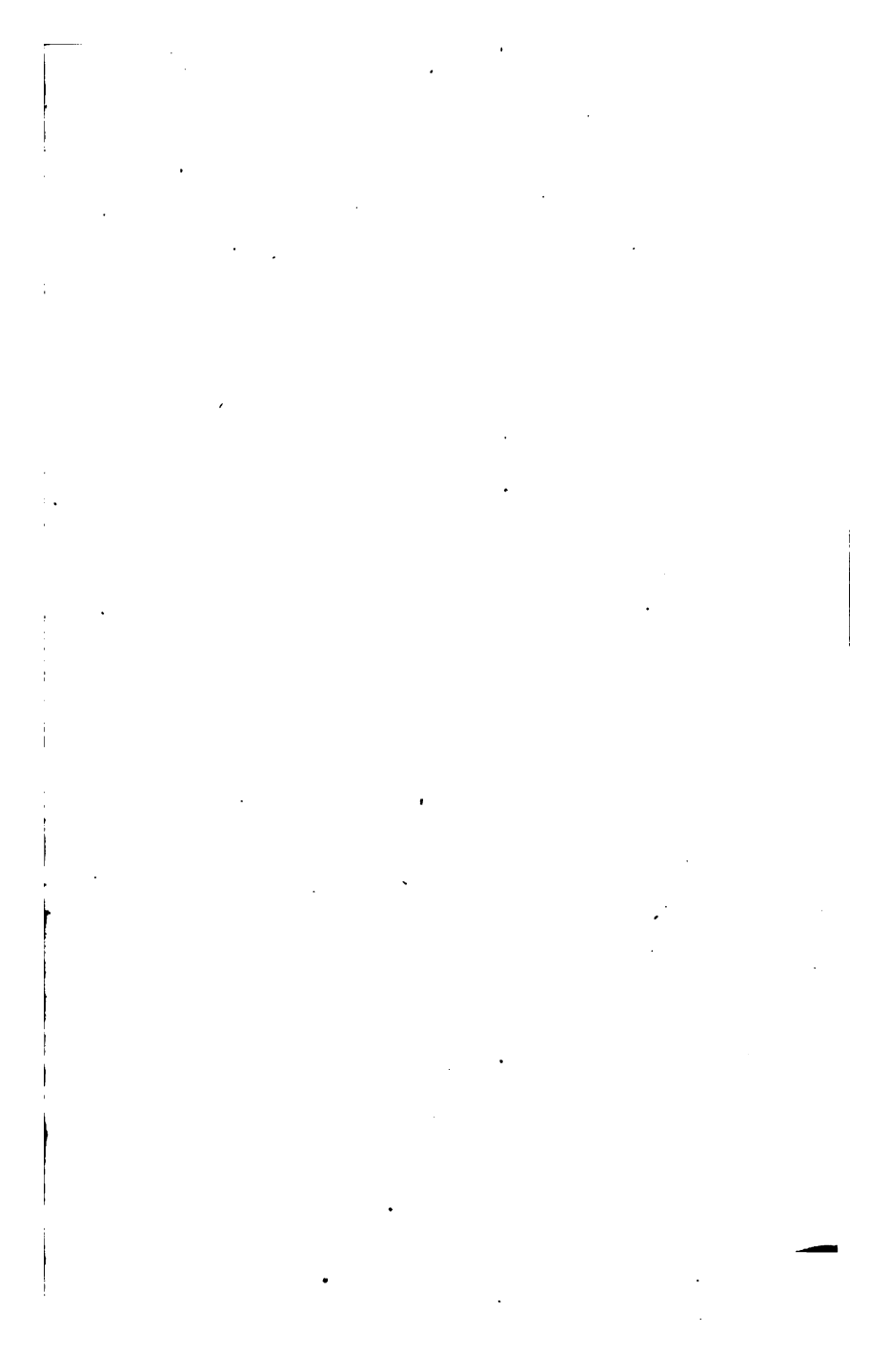
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Humble Servant,

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